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**Liu et al.**

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(54) **TRACTION MACHINE AND LIFTING EQUIPMENT**

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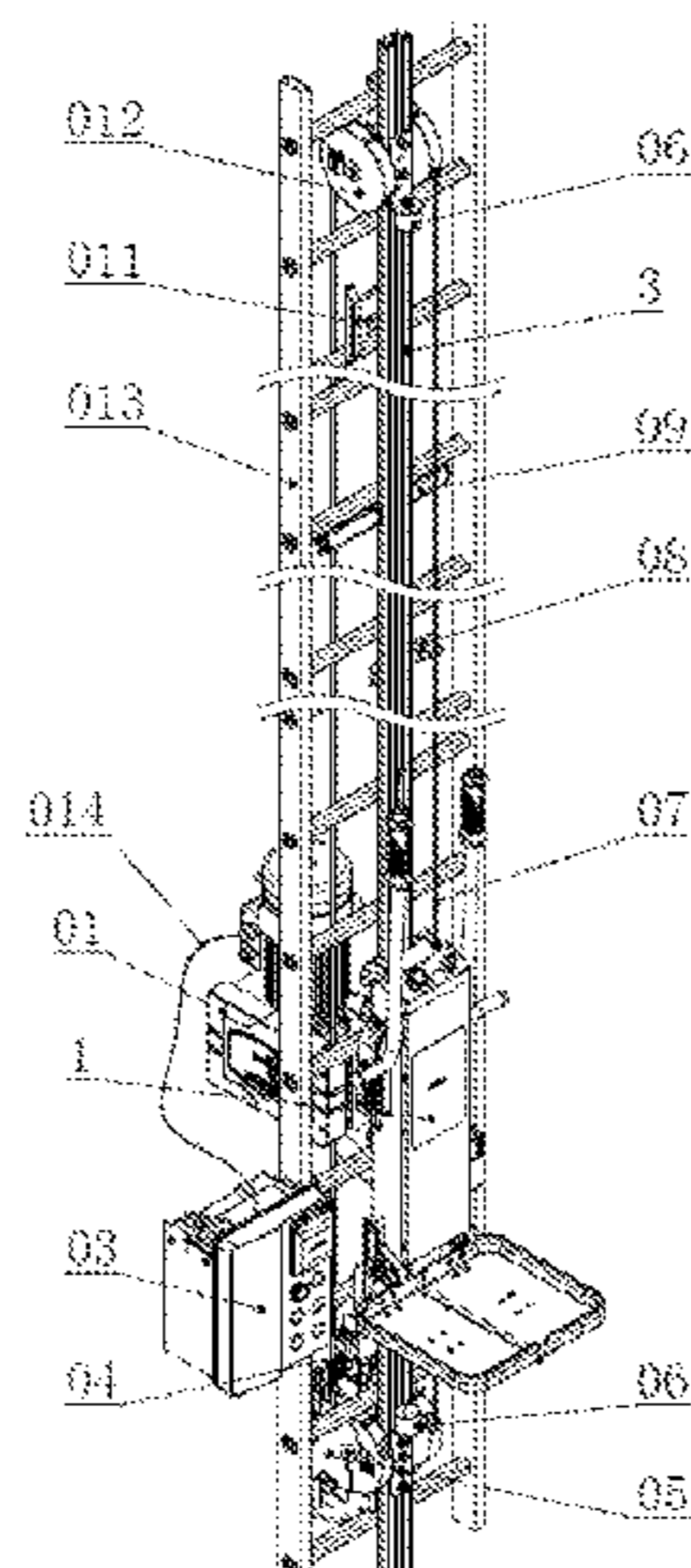
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Property Law Group LLP

(57) **ABSTRACT**

The present application relates to the technical field of lifting  
equipment, and provides a traction machine and a lifting  
equipment. The traction machine includes traction pulleys,  
traction ropes driven by the traction pulleys and fixed  
pulleys for changing directions of the traction ropes. The  
fixed pulley is provided with a sensor sensing member  
rotating with the fixed pulley, a traction machine sensor is  
arranged beside the fixed pulley; the traction machine sensor  
is configured to detect a rotation speed of the sensor sensing  
member, and send the rotation speed to a controller of the  
traction machine; the controller controls a rotation of the  
traction pulley according to detected data of the traction  
machine sensor. Since this kind of traction machine is  
provided with the sensor sensing member and the traction  
machine sensor, it is capable of detecting whether the  
(Continued)



traction machine has an abnormal operation, and stopping the traction machine immediately in an abnormal state.

**20 Claims, 17 Drawing Sheets**

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**B66B 5/00** (2006.01)  
**B66B 5/04** (2006.01)  
**B66B 5/18** (2006.01)  
**B66B 9/00** (2006.01)  
**B66B 11/00** (2006.01)  
**E06C 7/18** (2006.01)  
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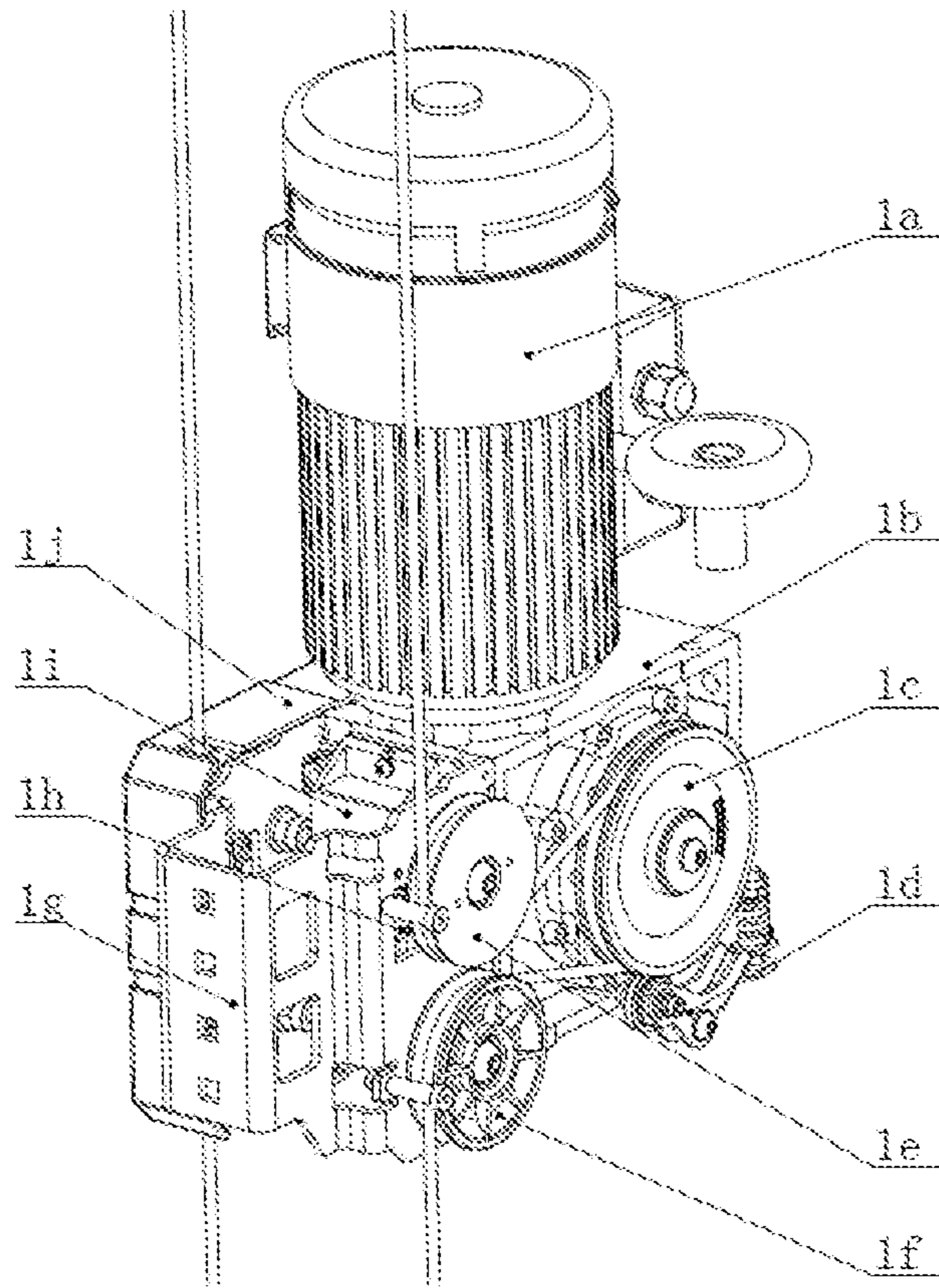
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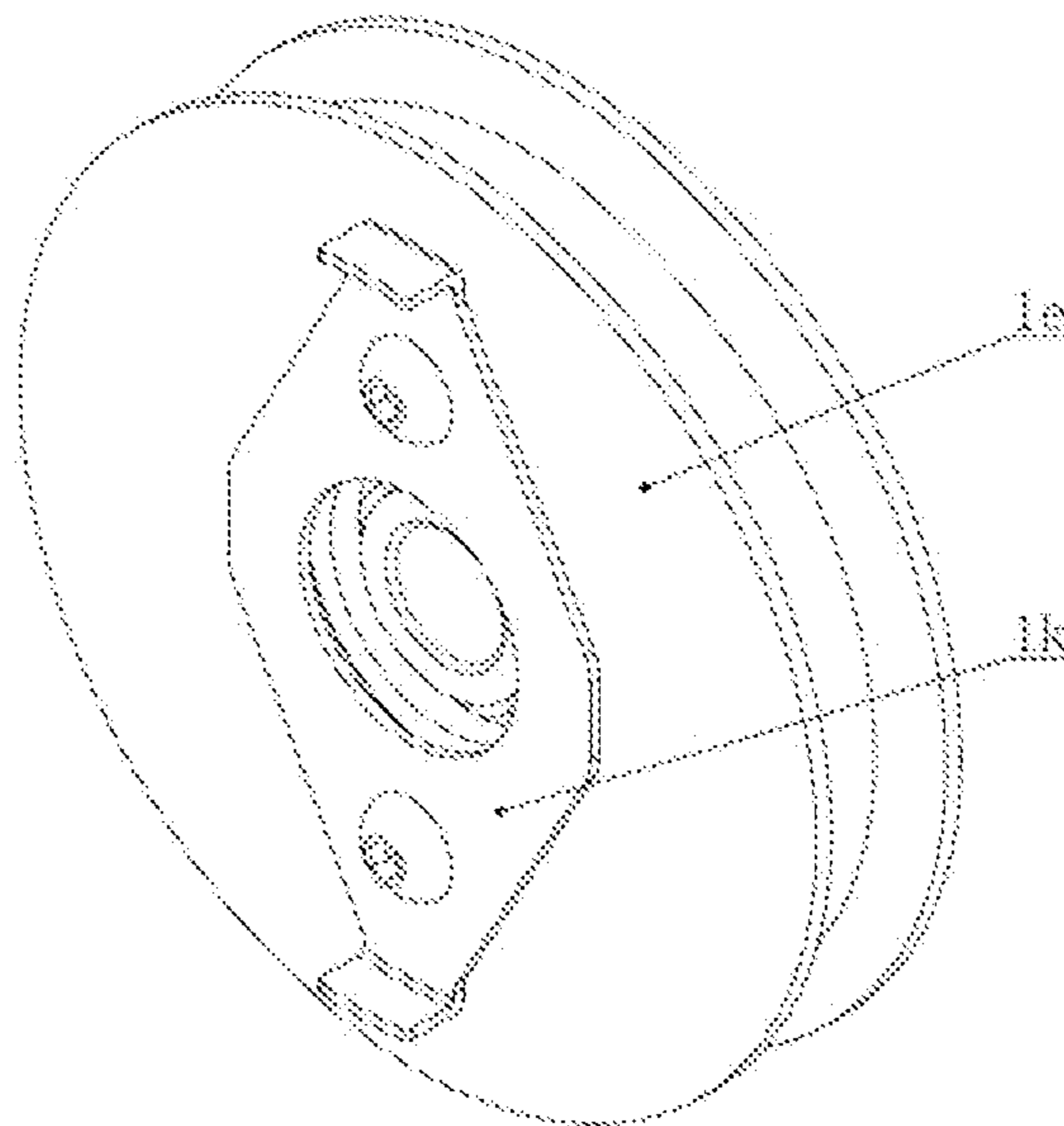
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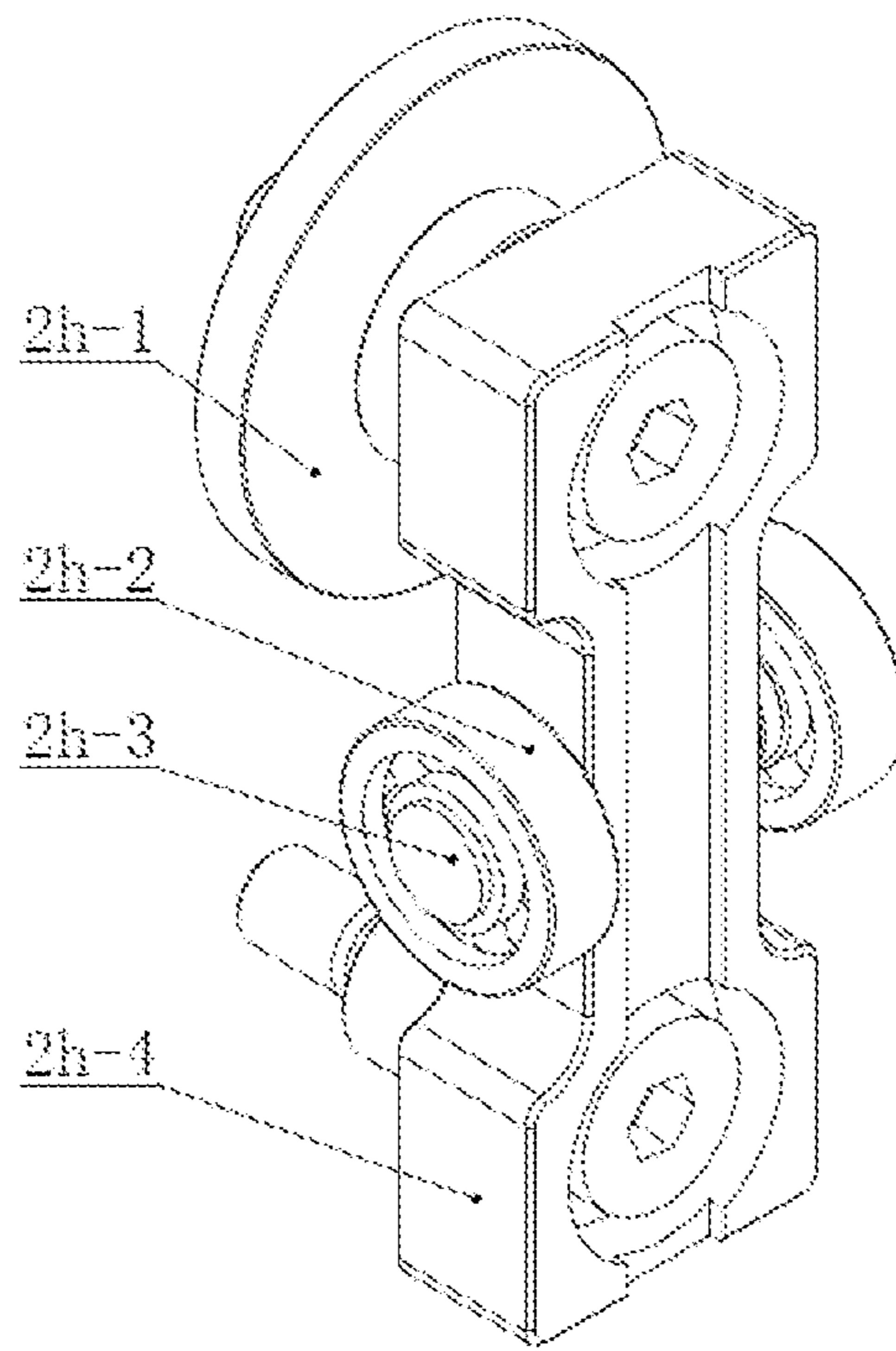


**Fig. 1**

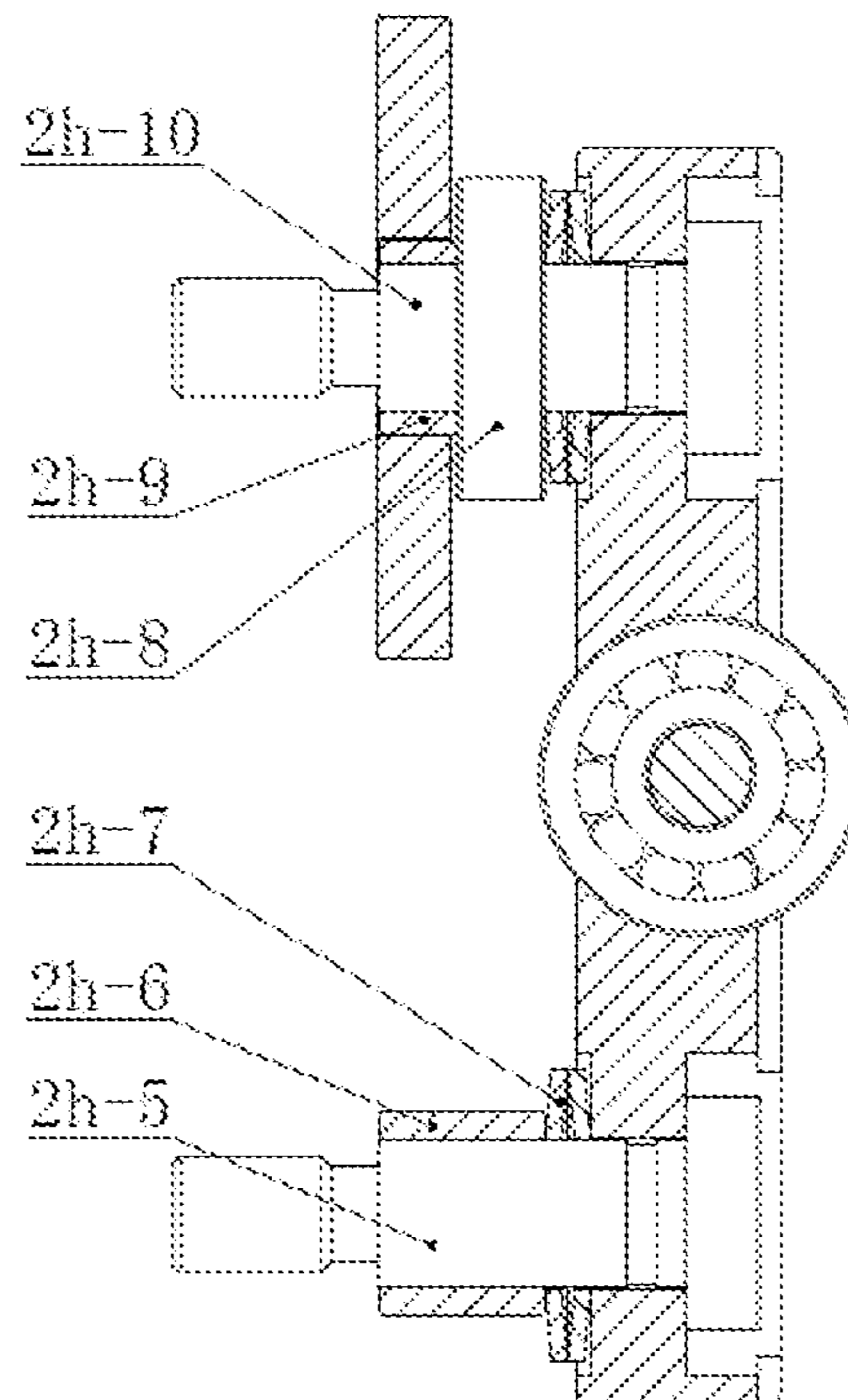


**Fig. 2**

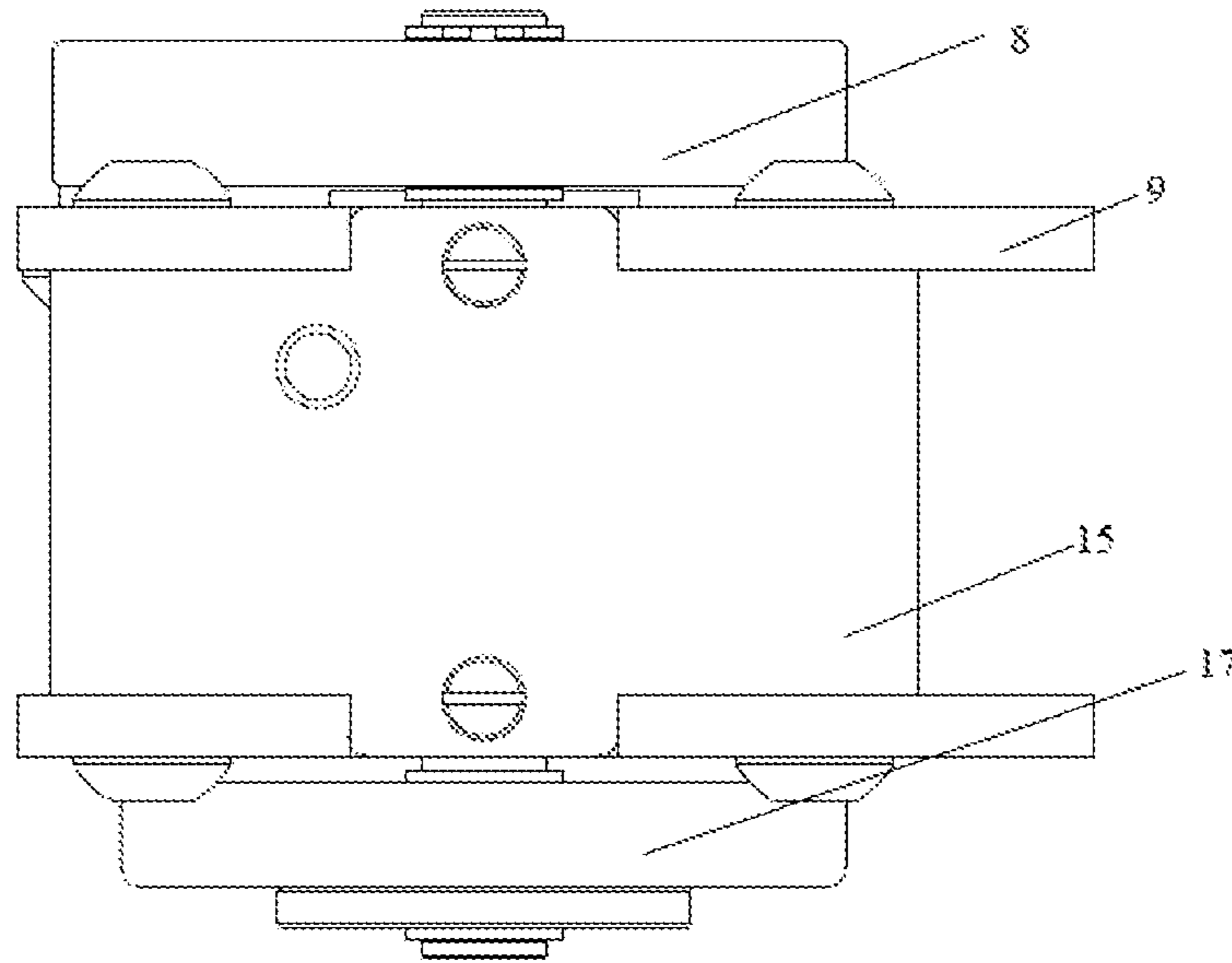




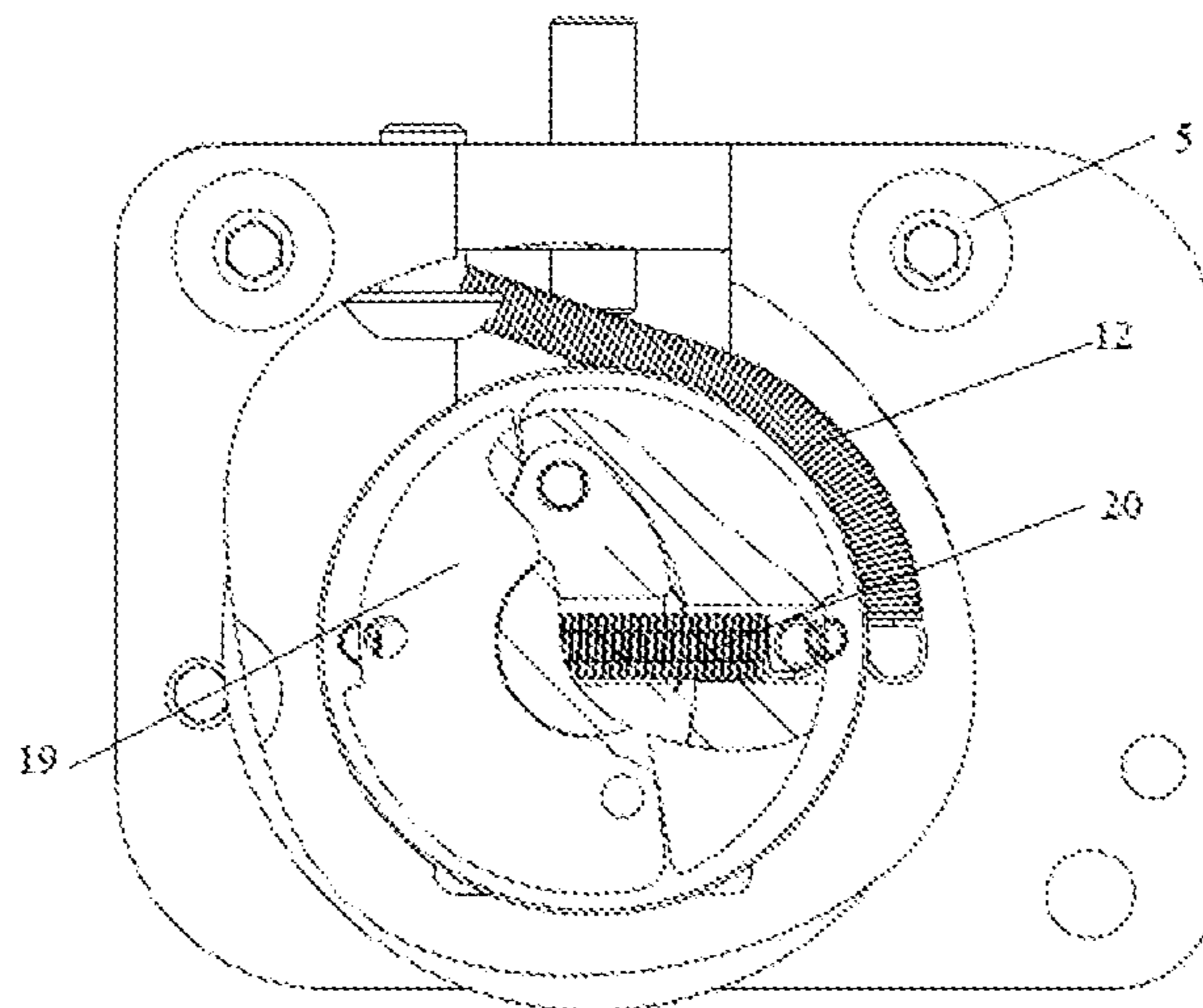
**Fig. 3**



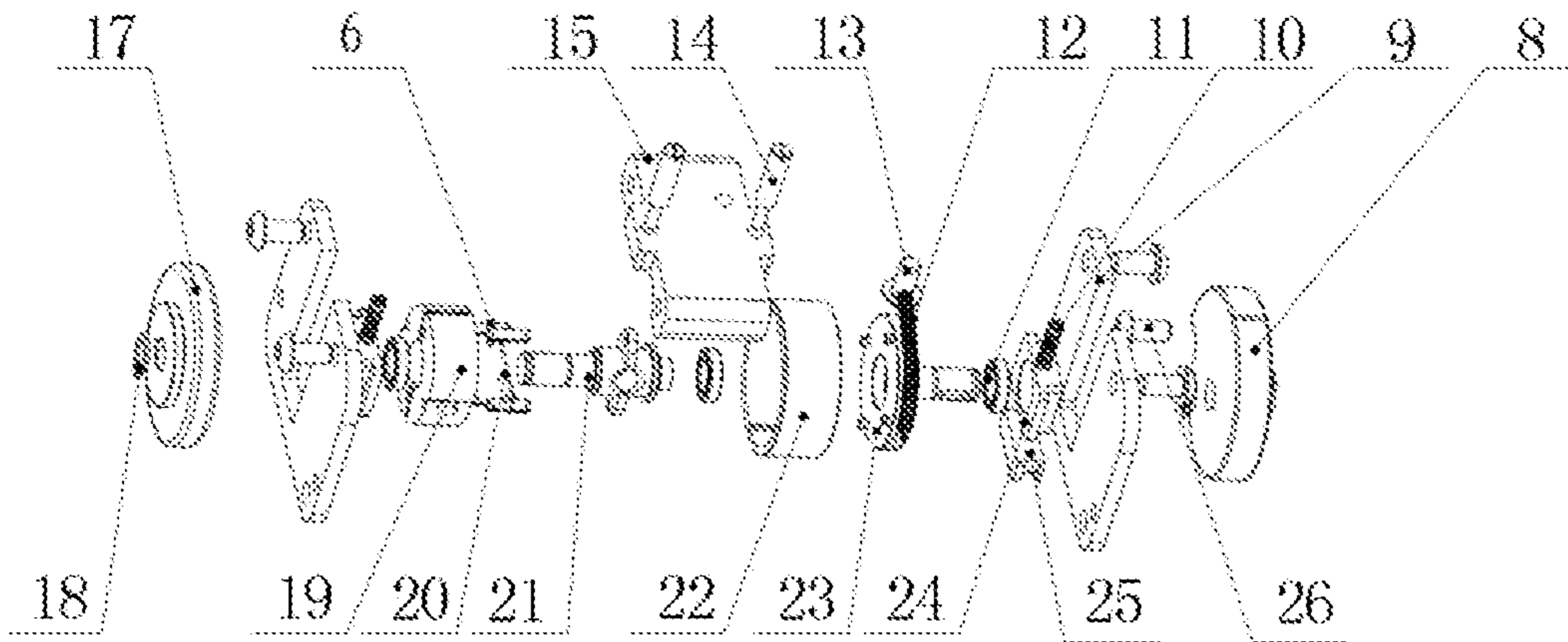
**Fig. 4**



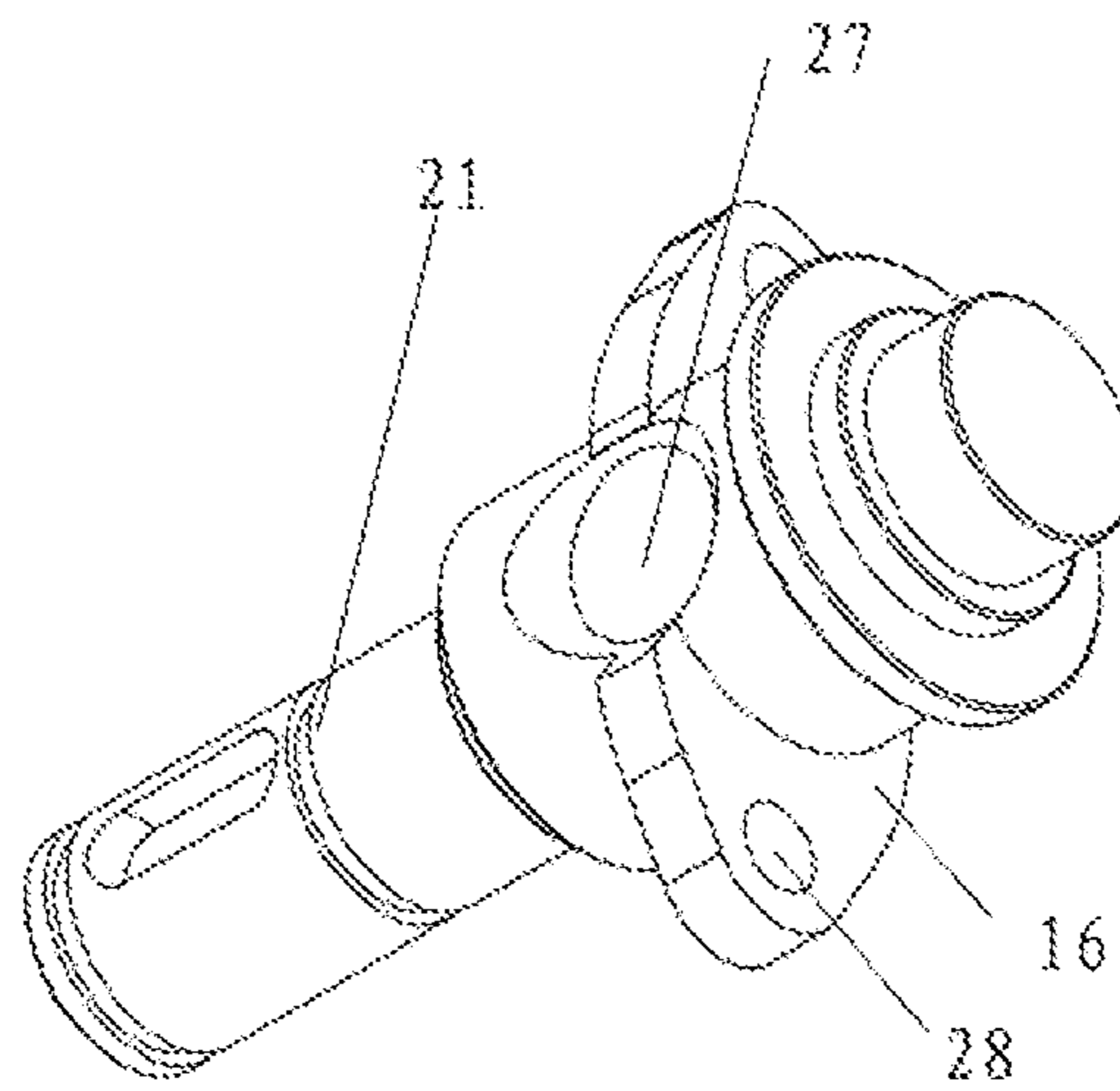
**Fig. 5**



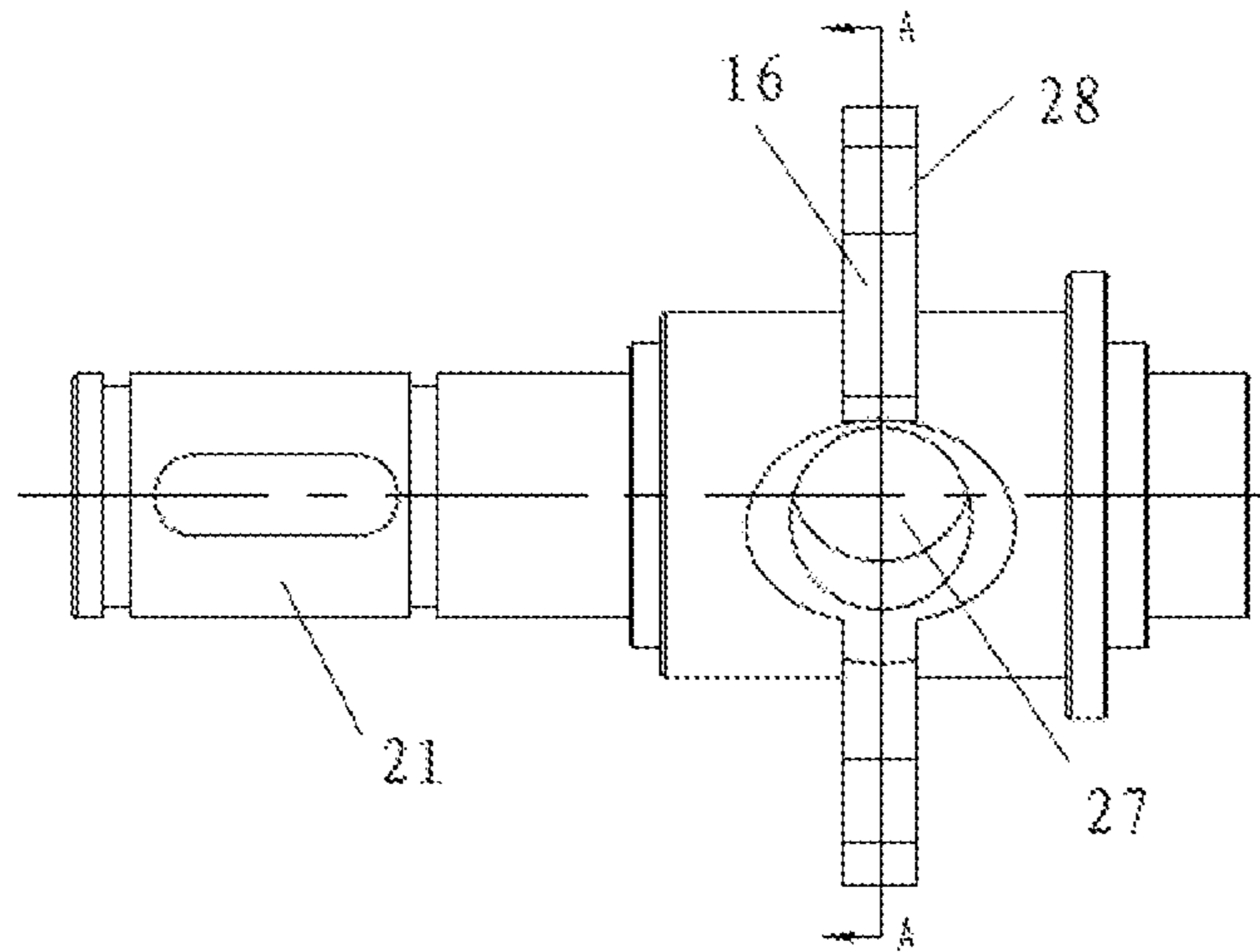
**Fig. 6**



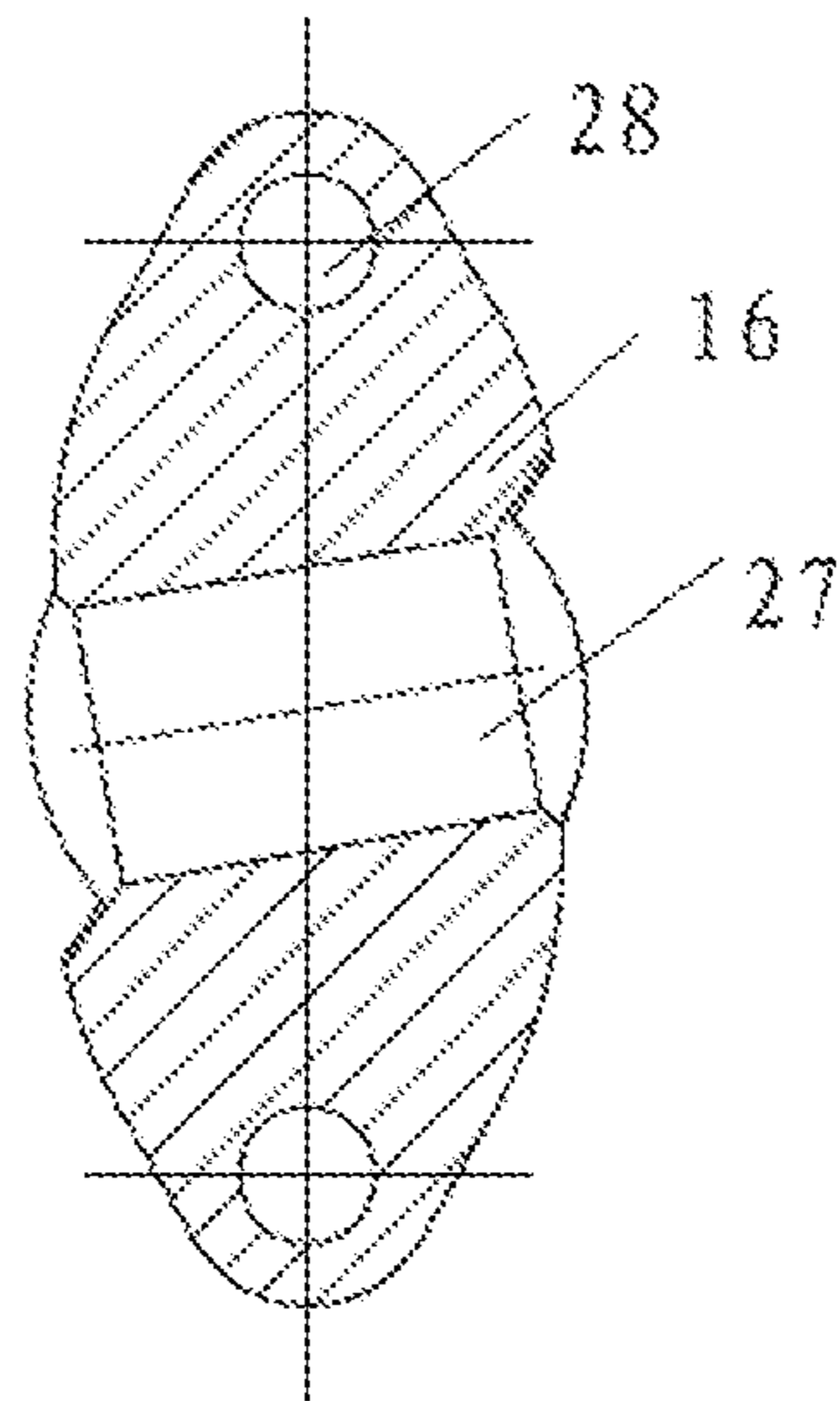
**Fig. 7**



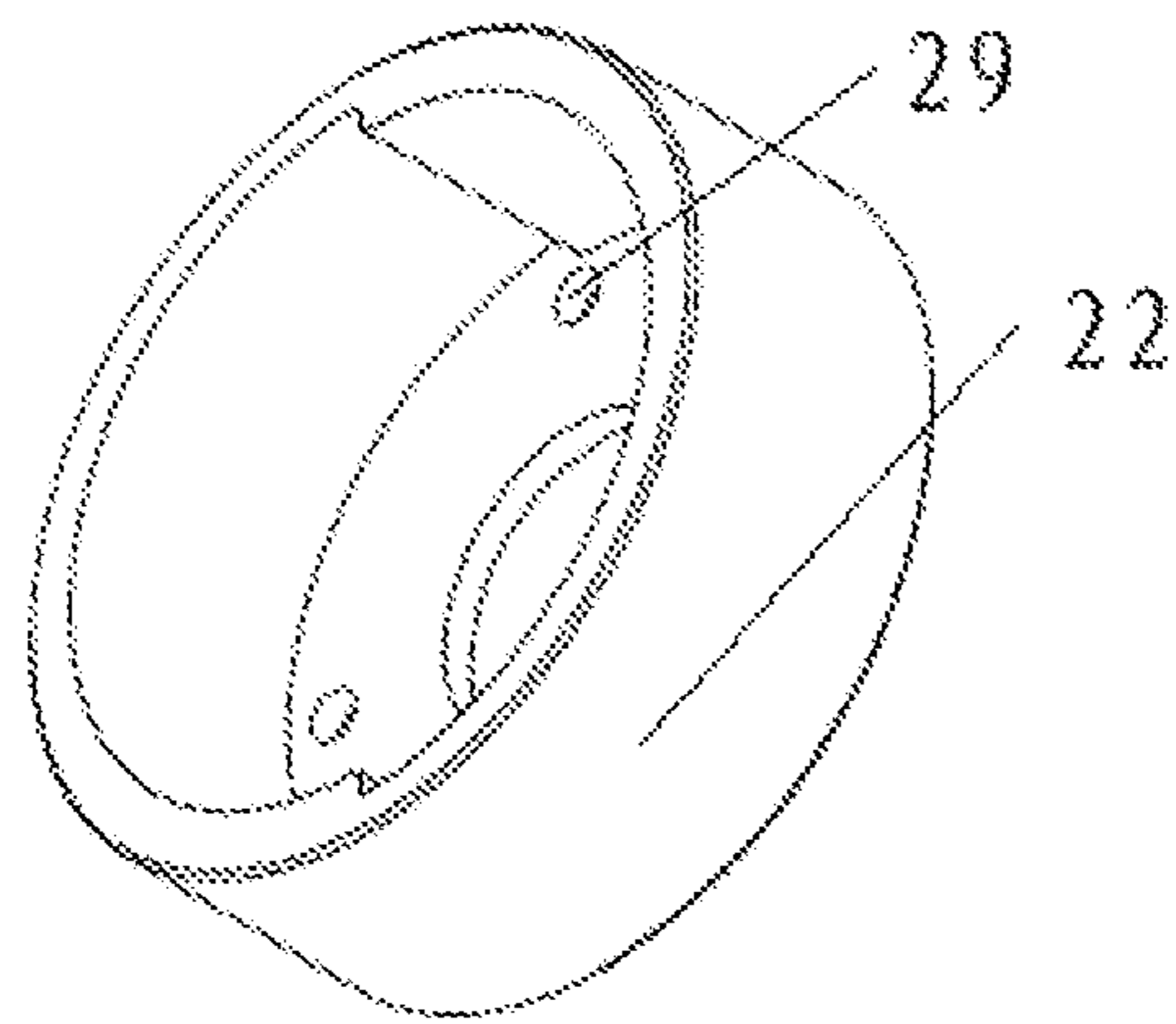
**Fig. 8**



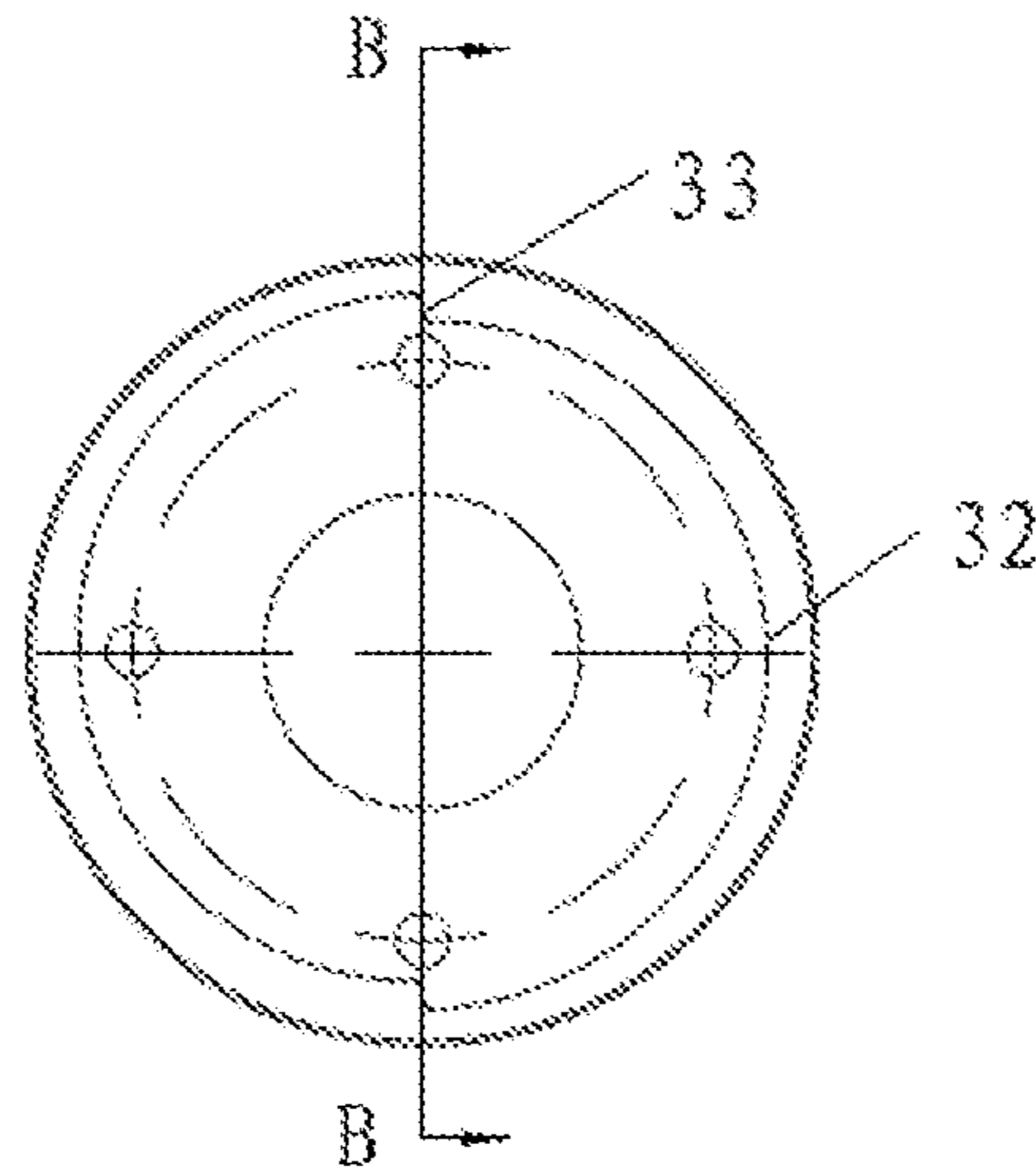
**Fig. 9**



**Fig. 10**

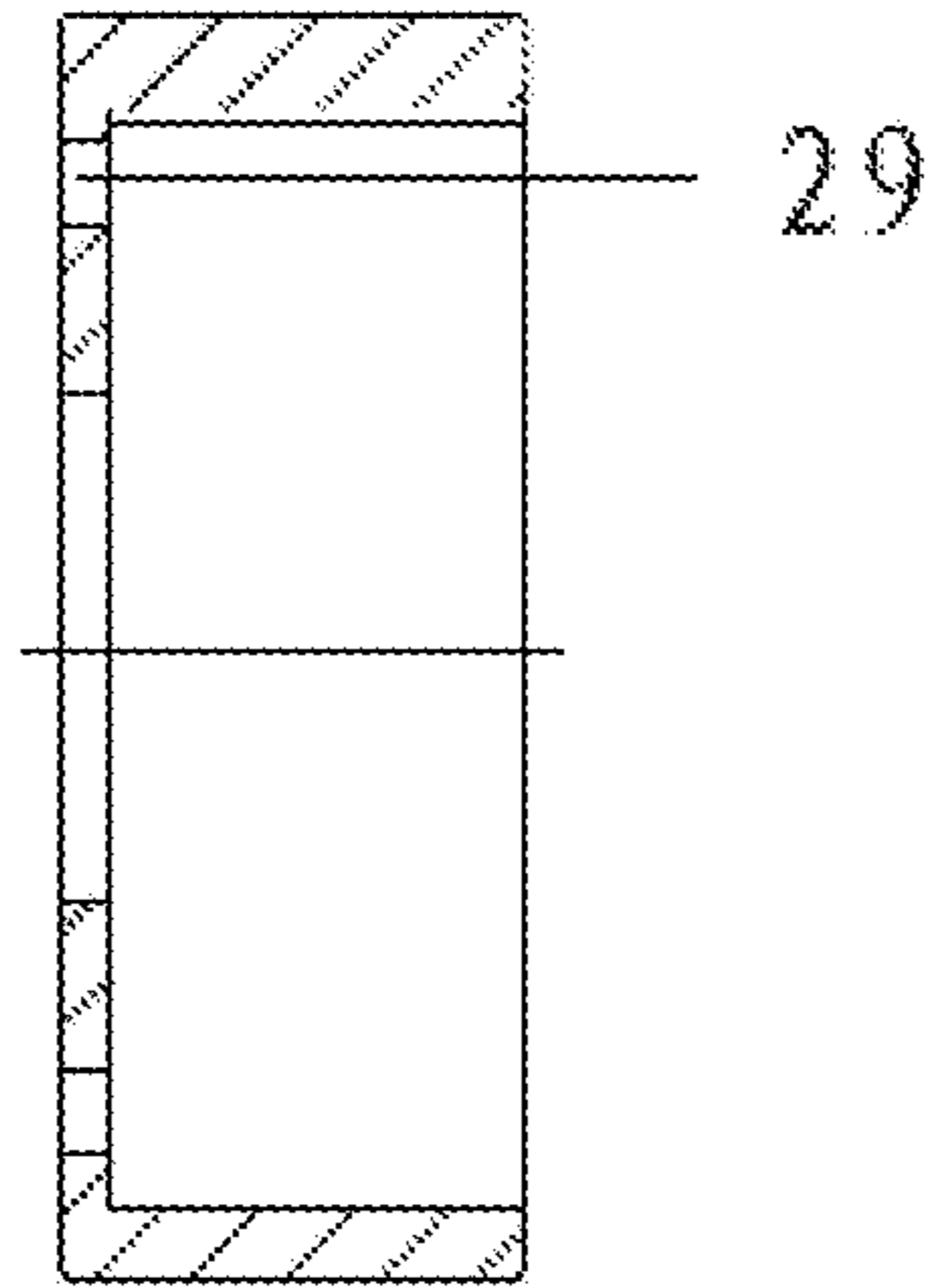


**Fig. 11**

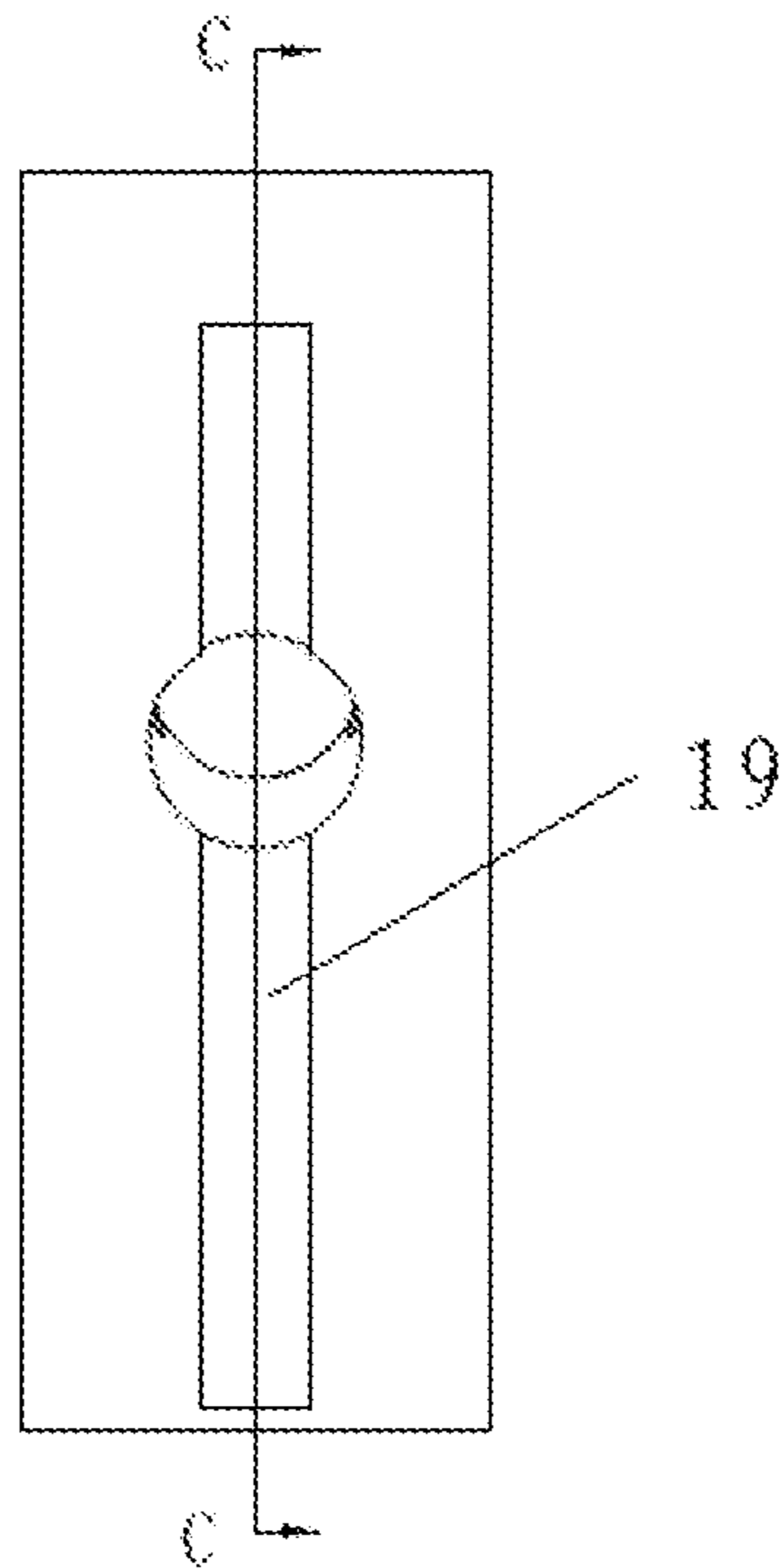


**Fig. 12**

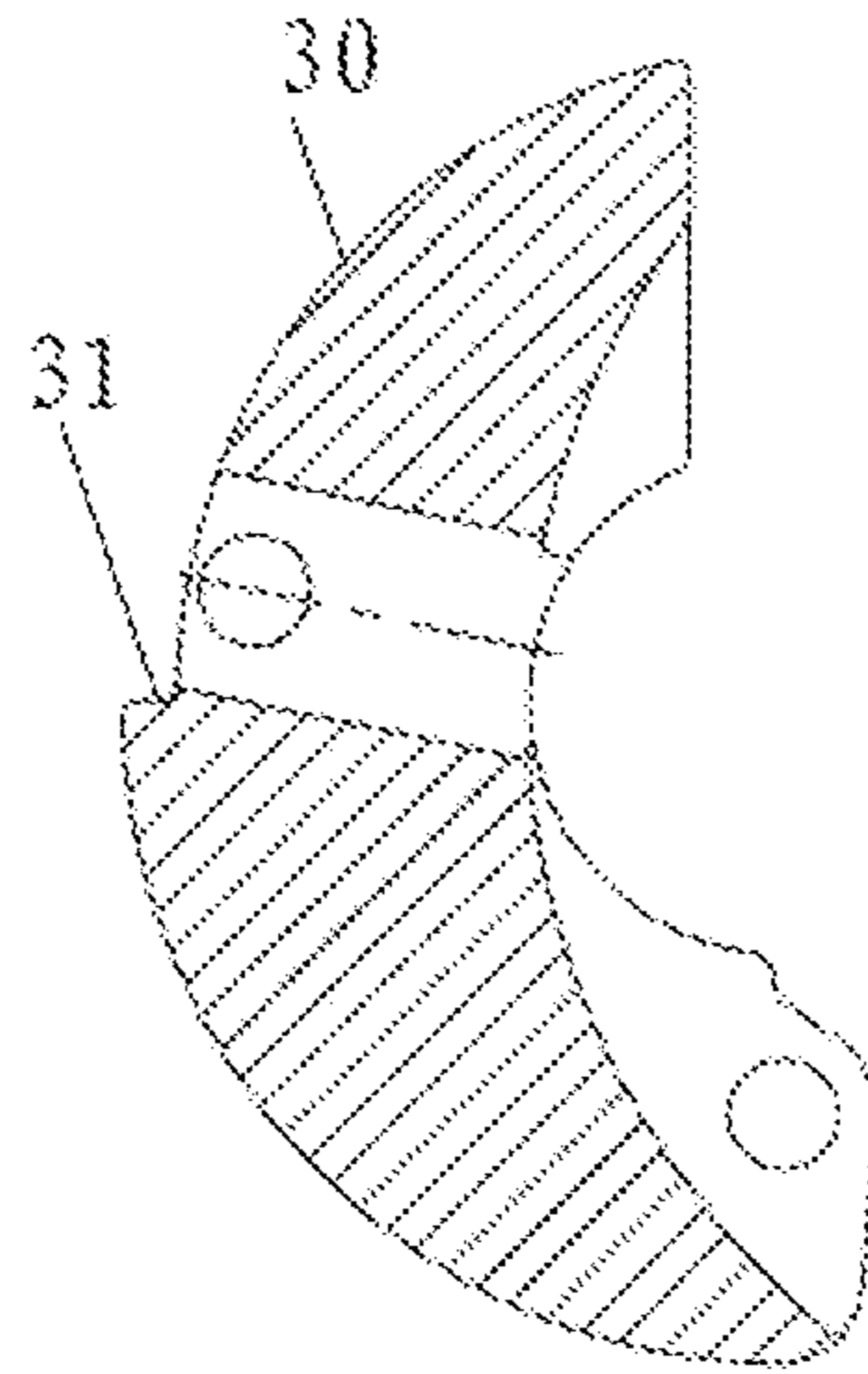




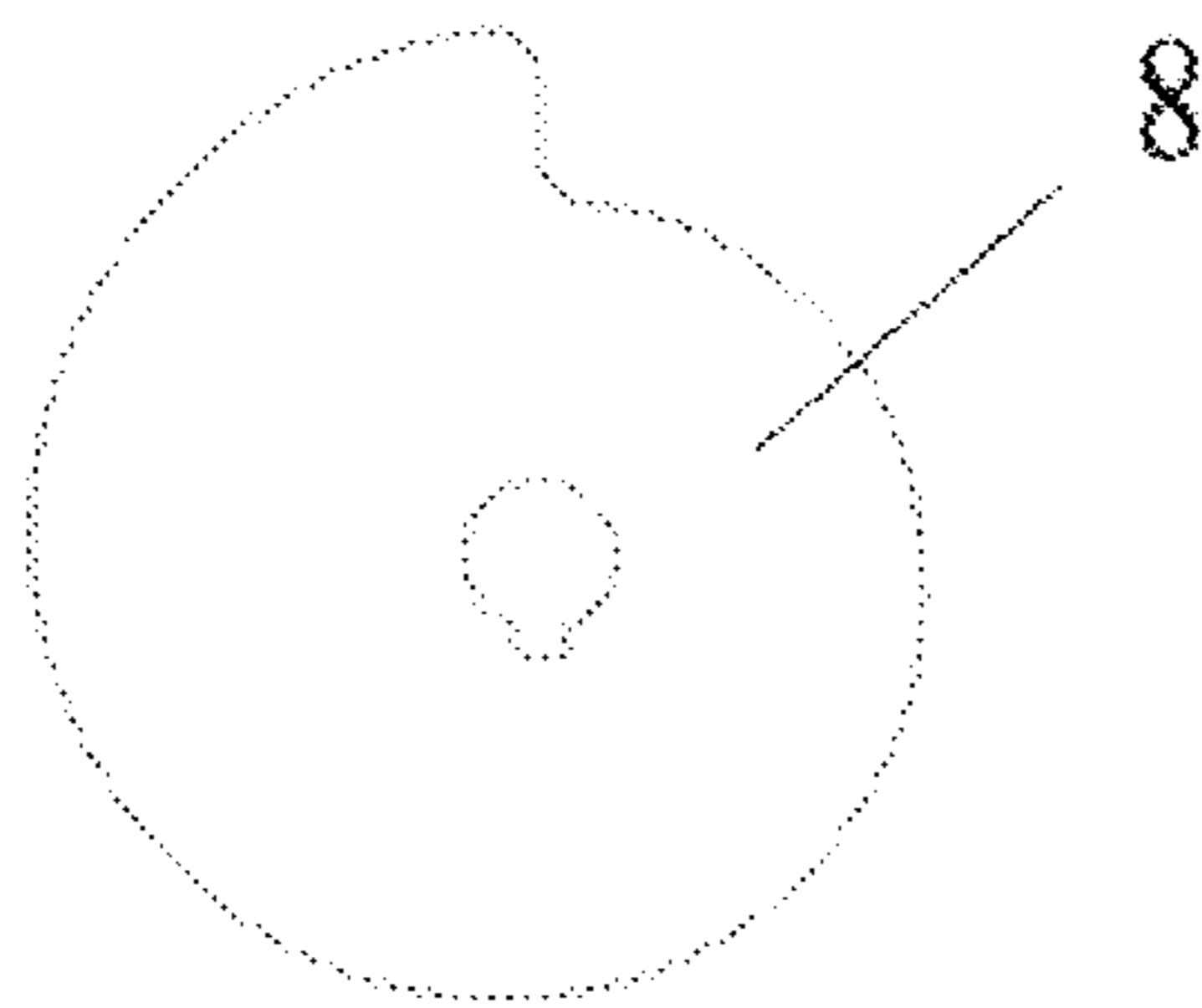
**Fig. 13**



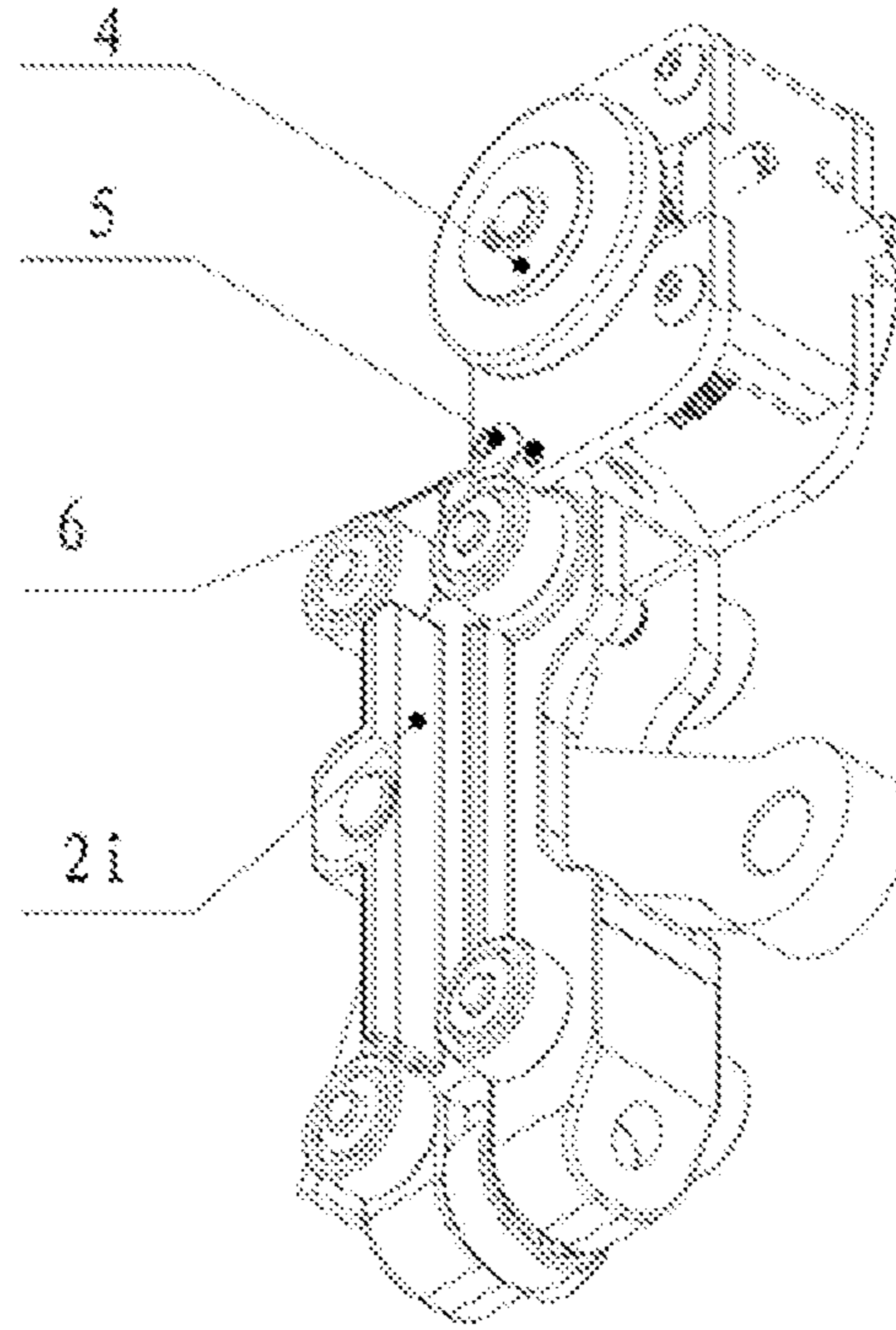
**Fig. 14**



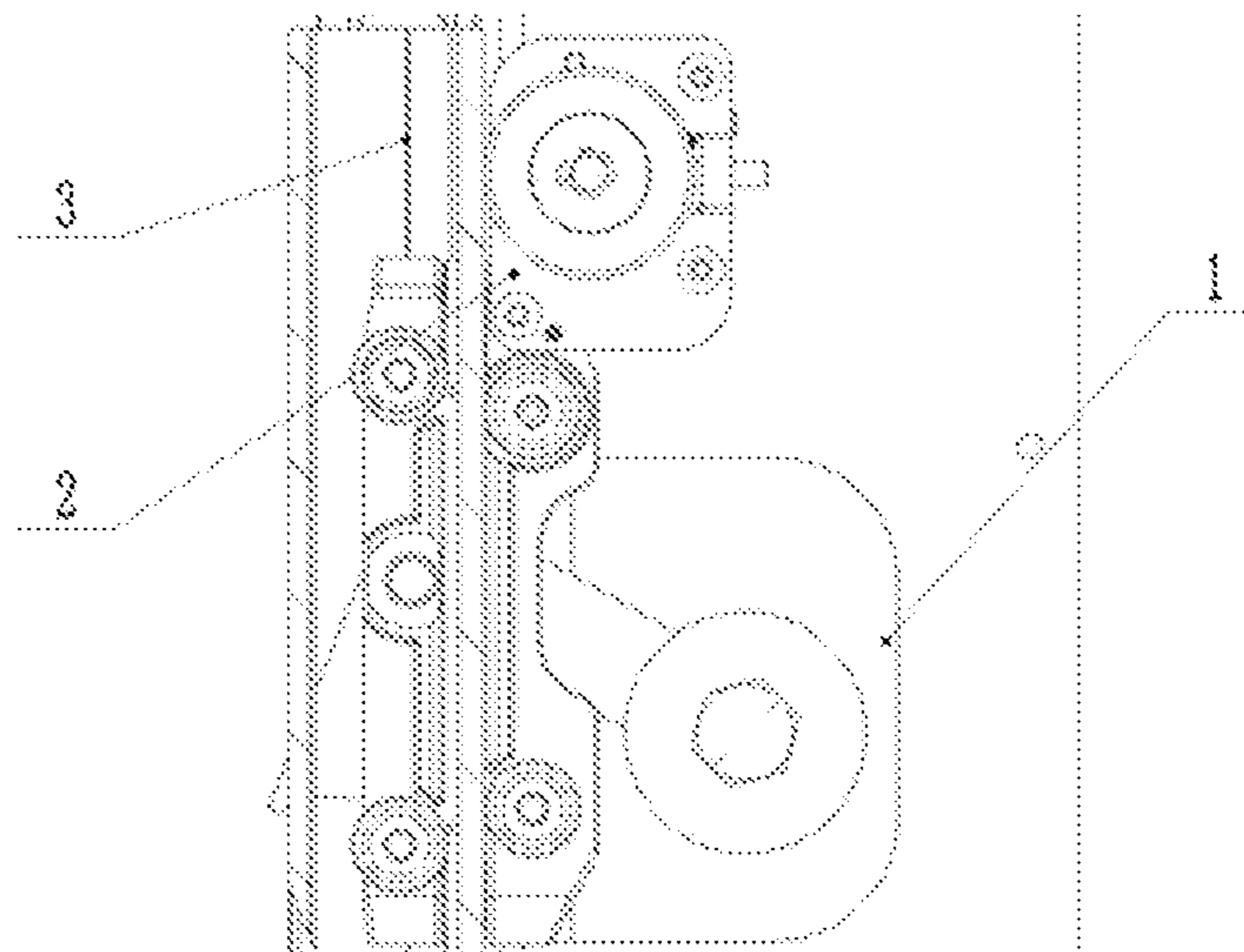
**Fig. 15**



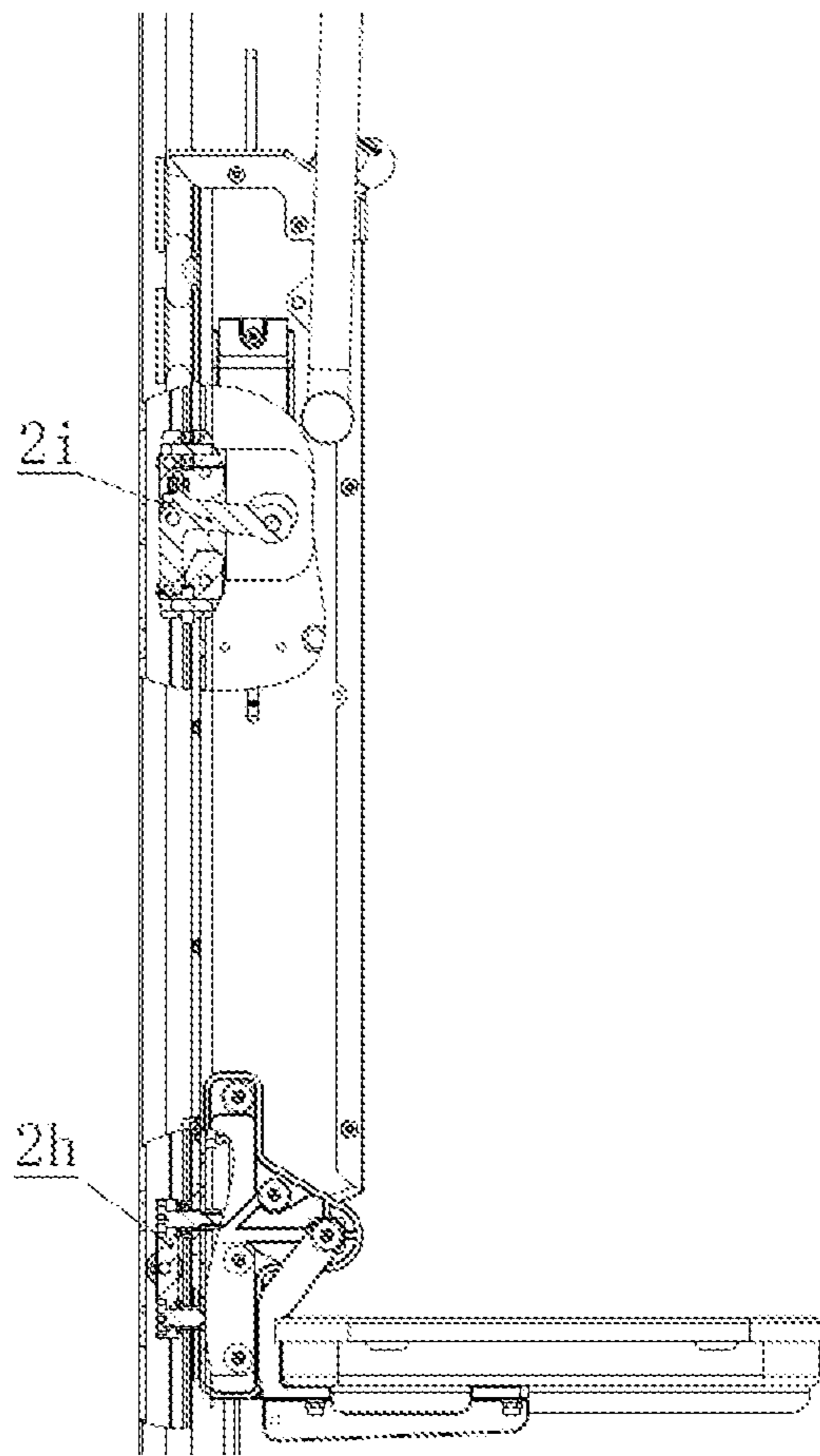
**Fig. 16**



**Fig. 17**

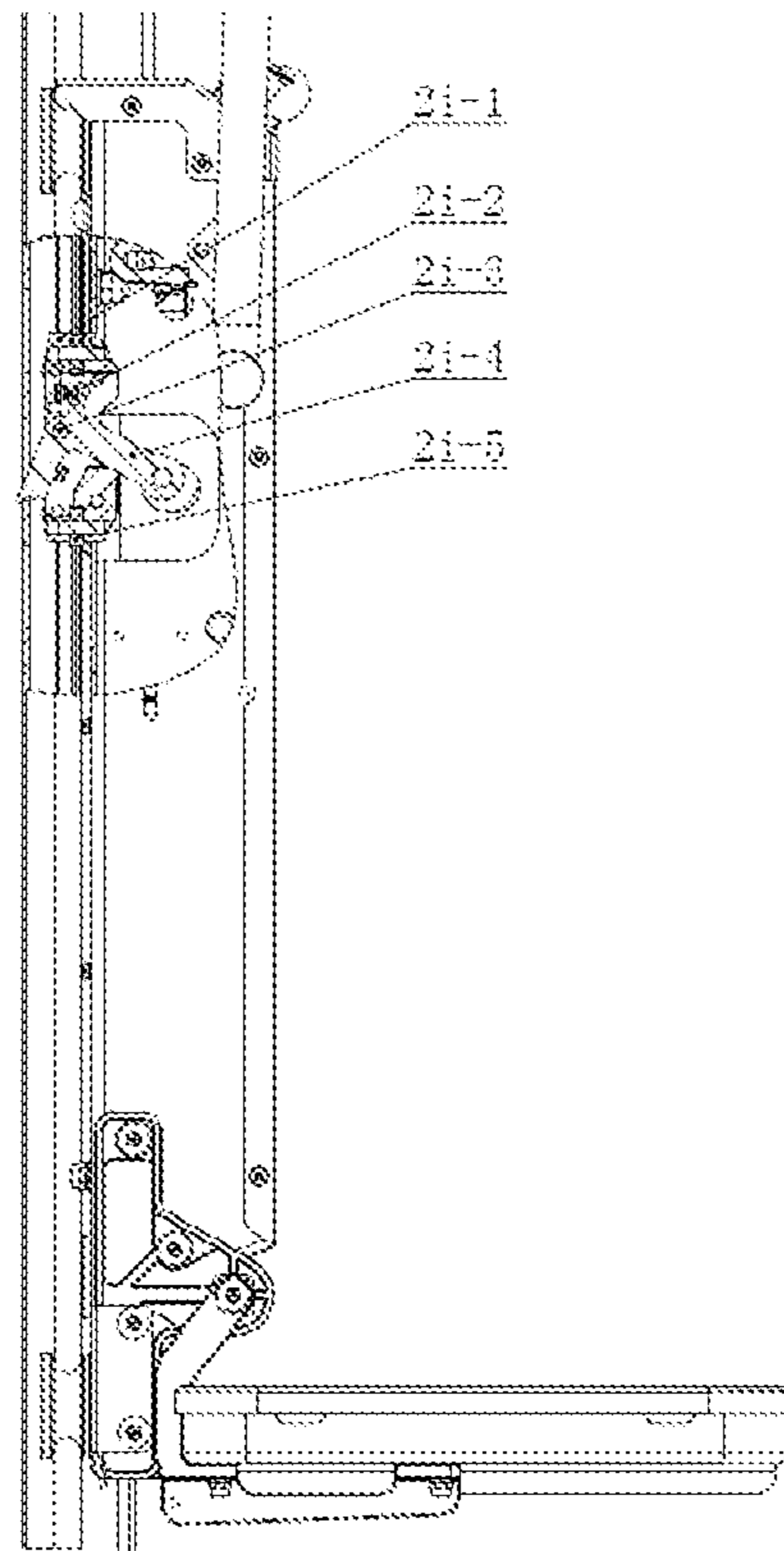


**Fig. 18**

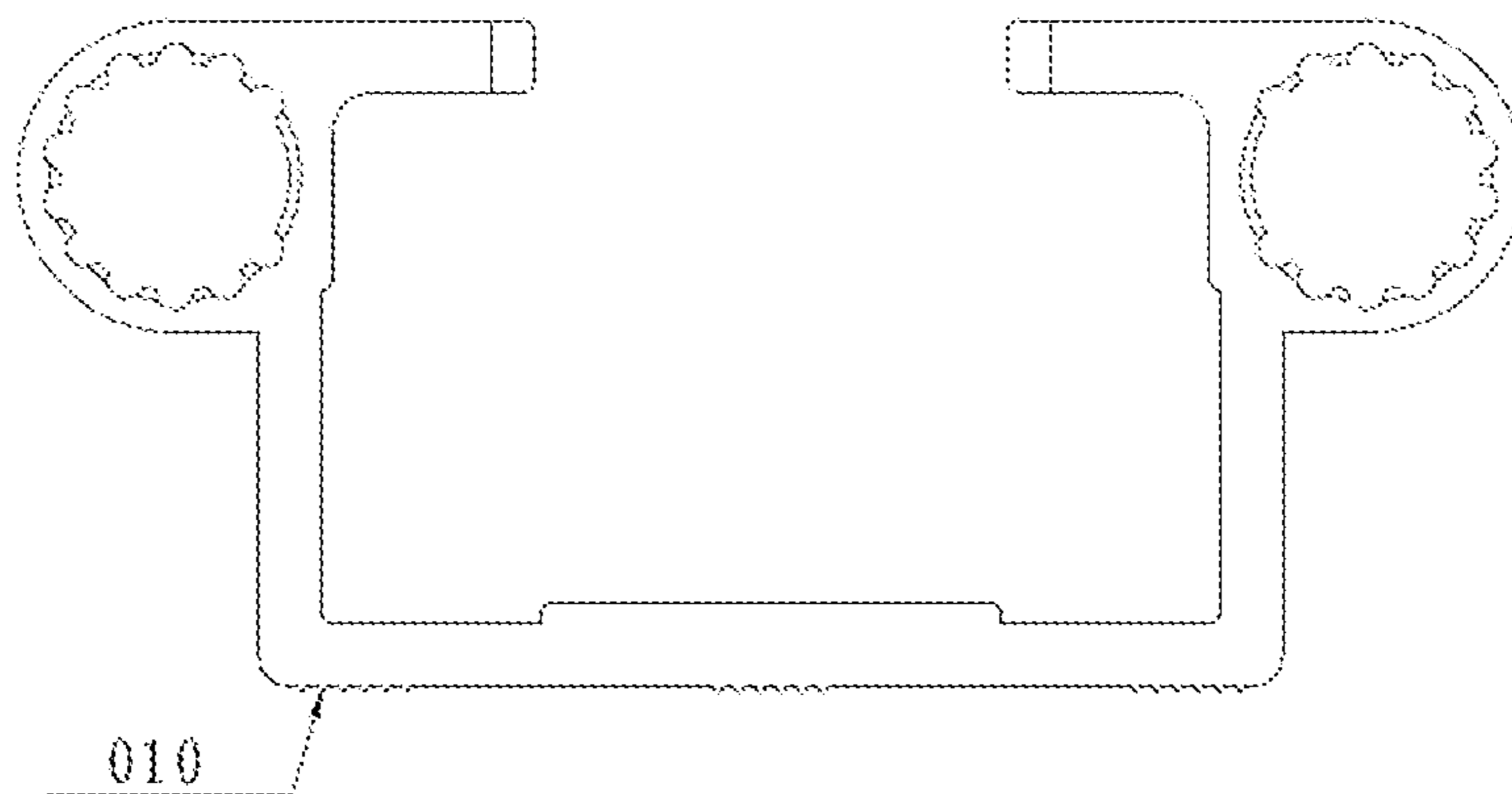


*Fig. 19*

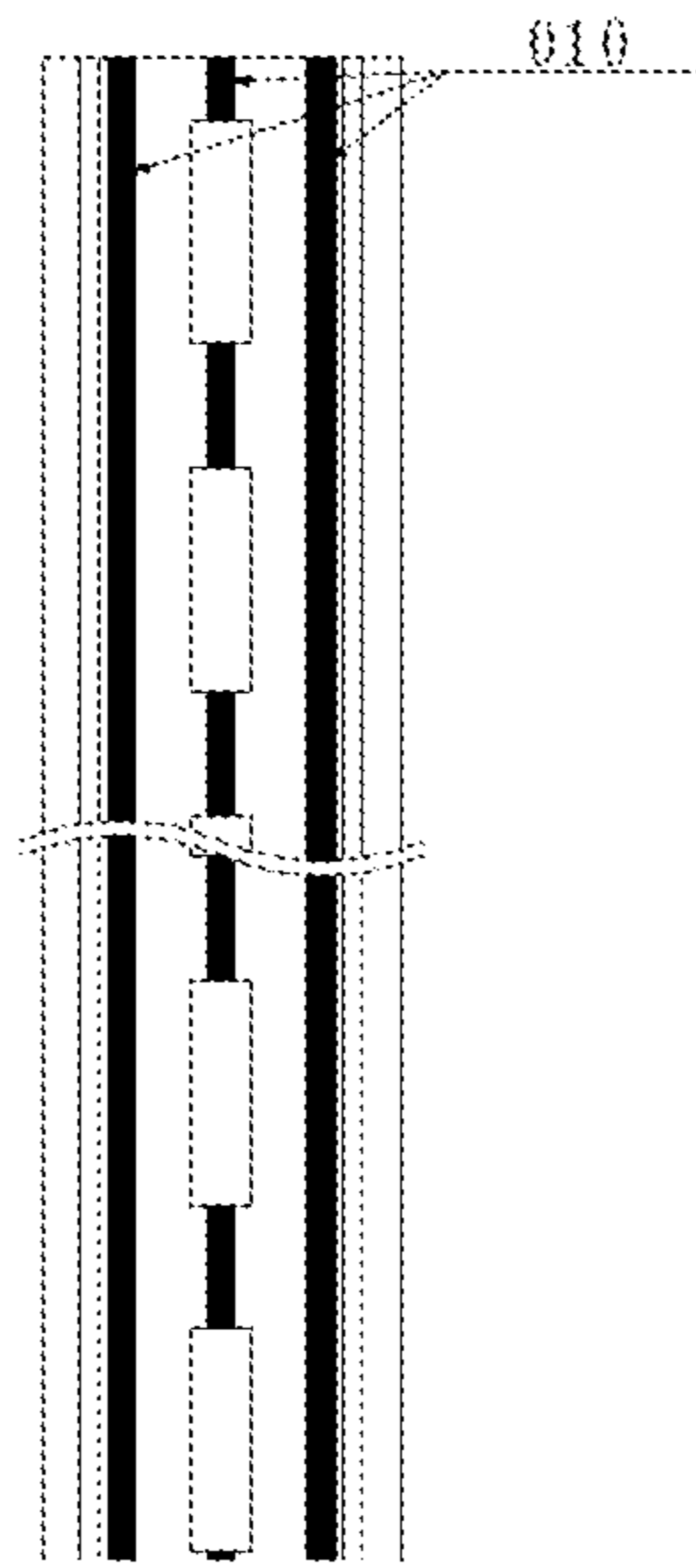




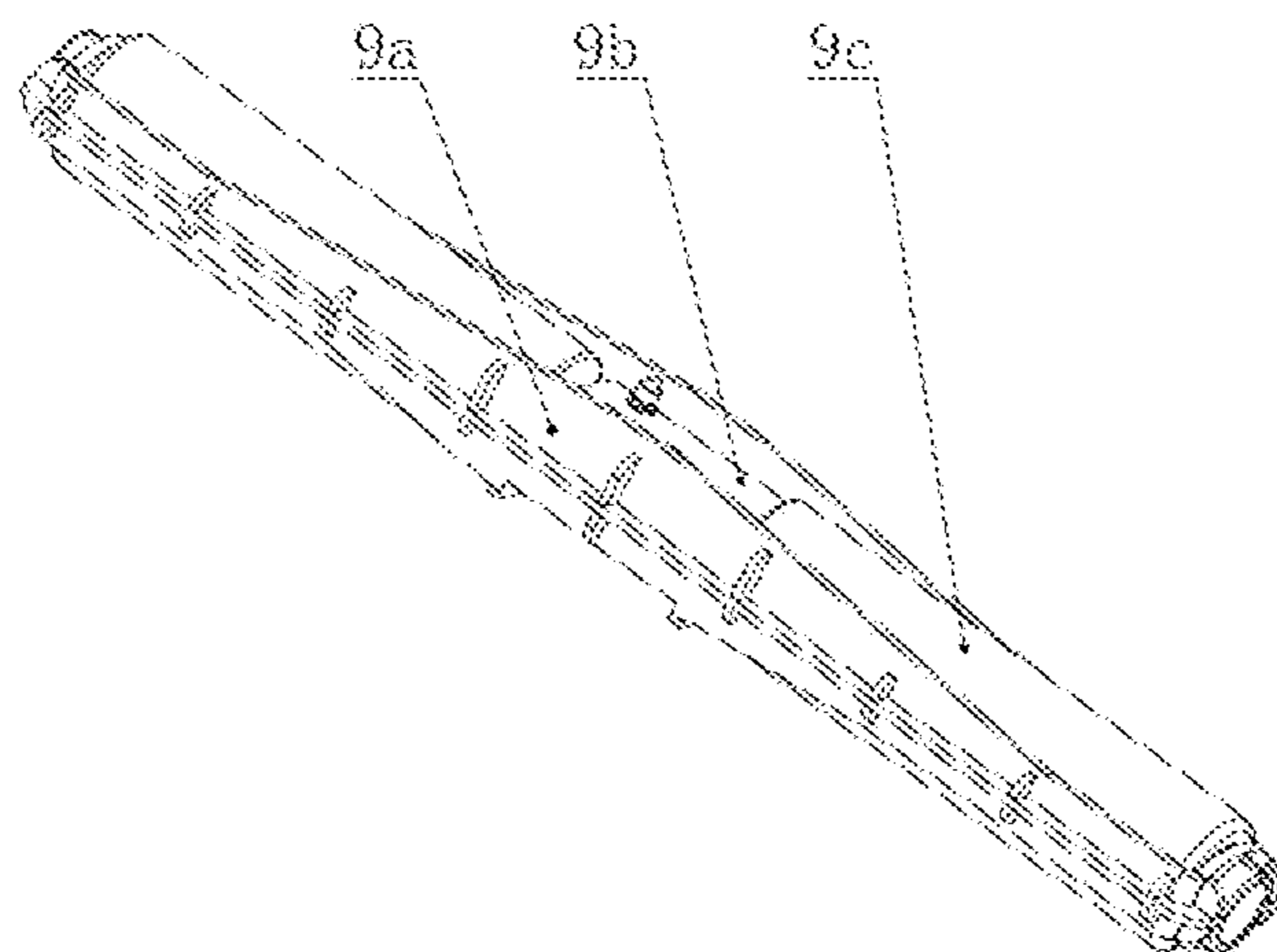
**Fig. 20**



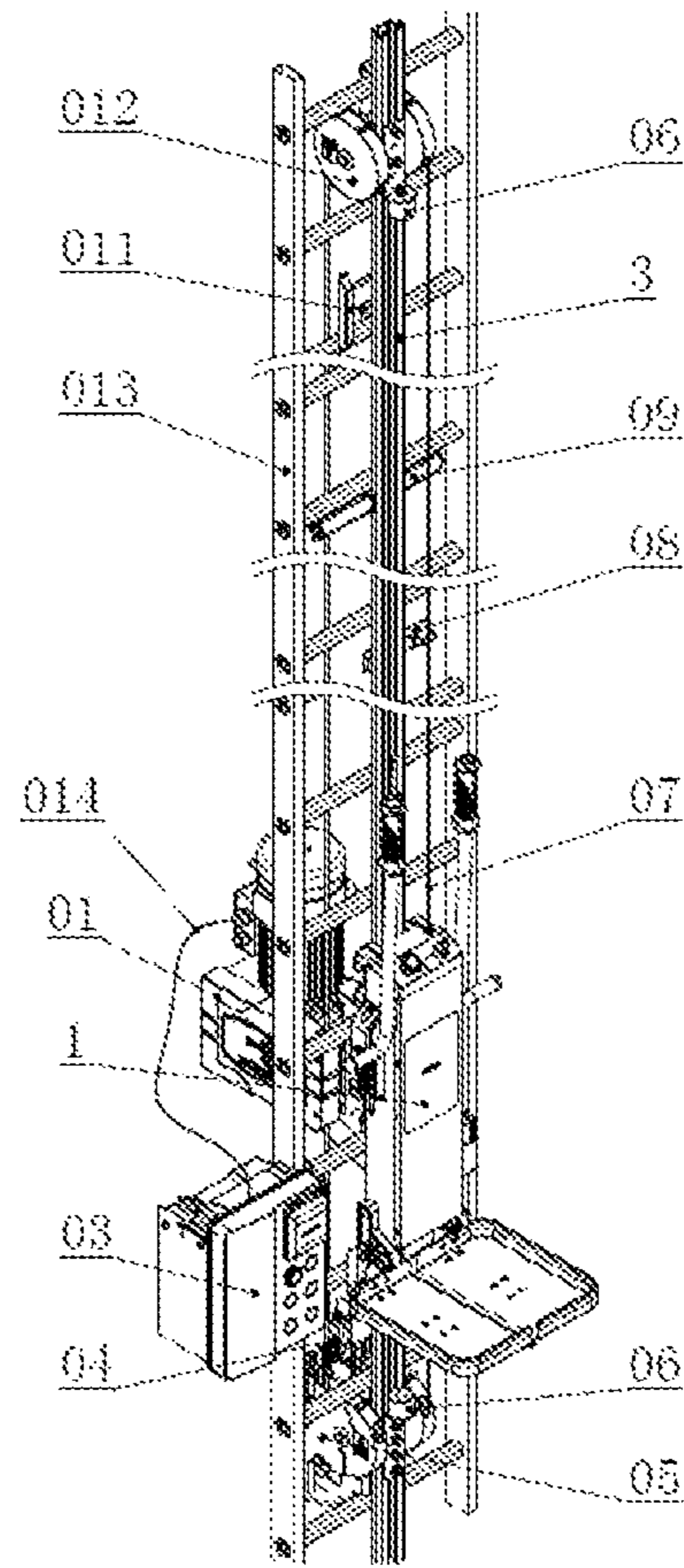
**Fig. 21**



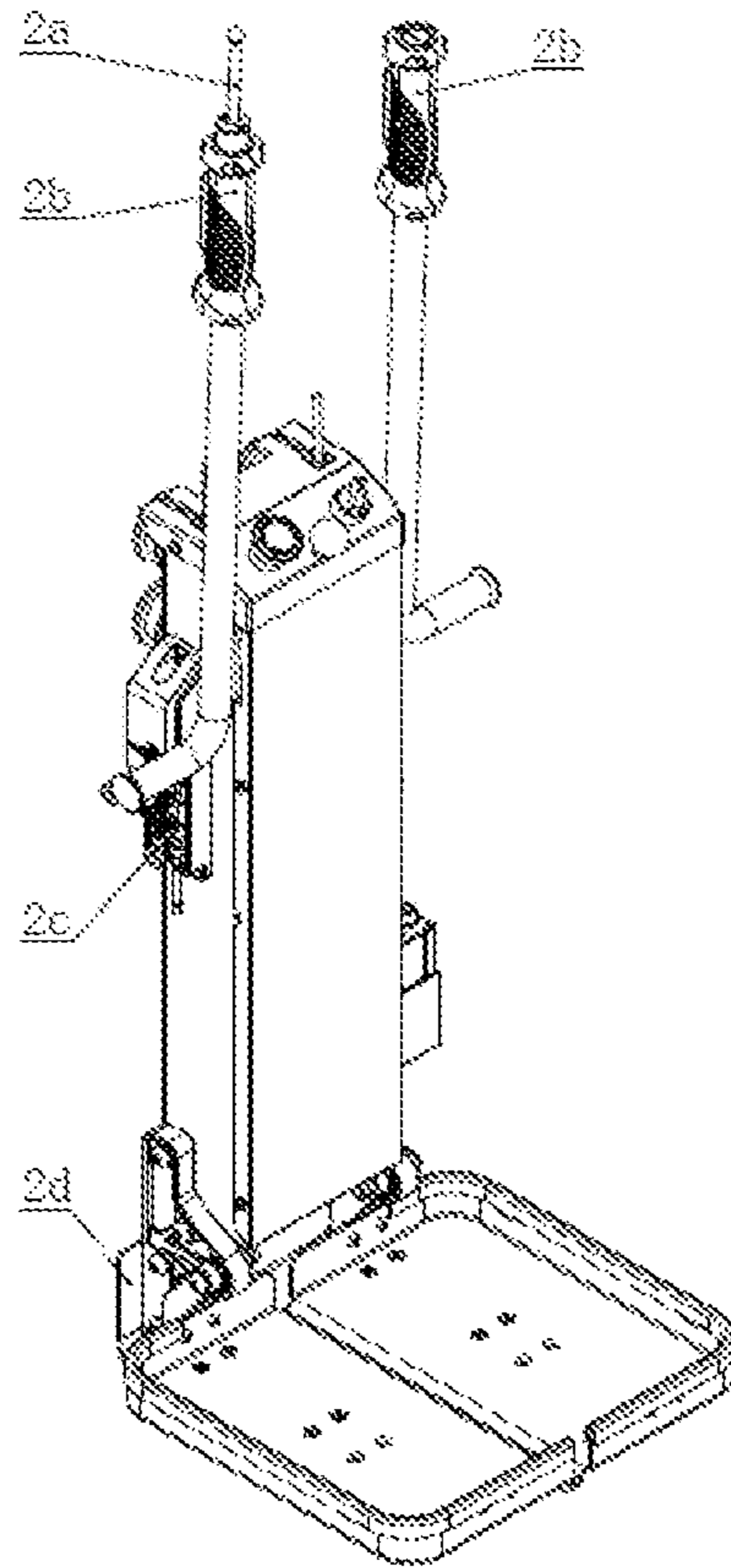
*Fig. 22*



*Fig. 23*

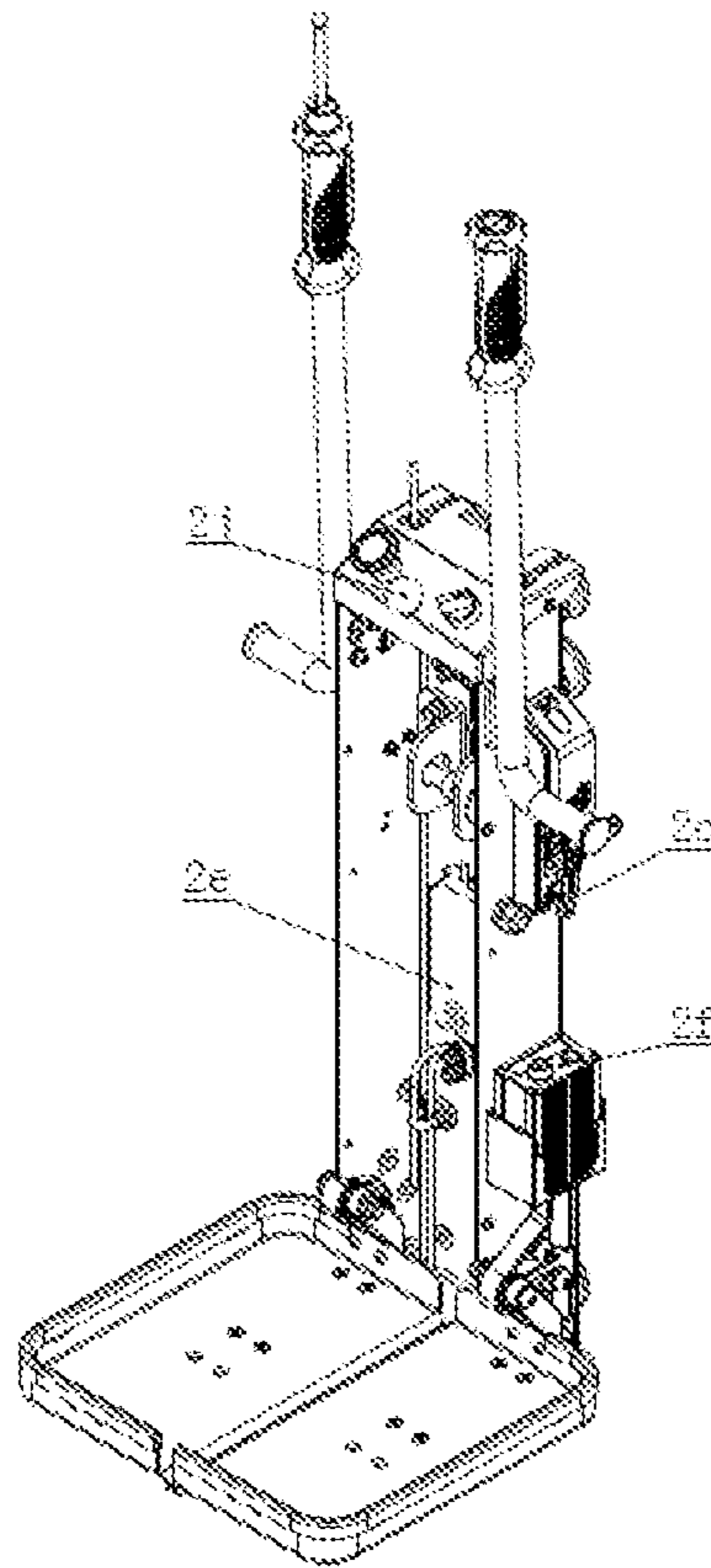


*Fig. 24*

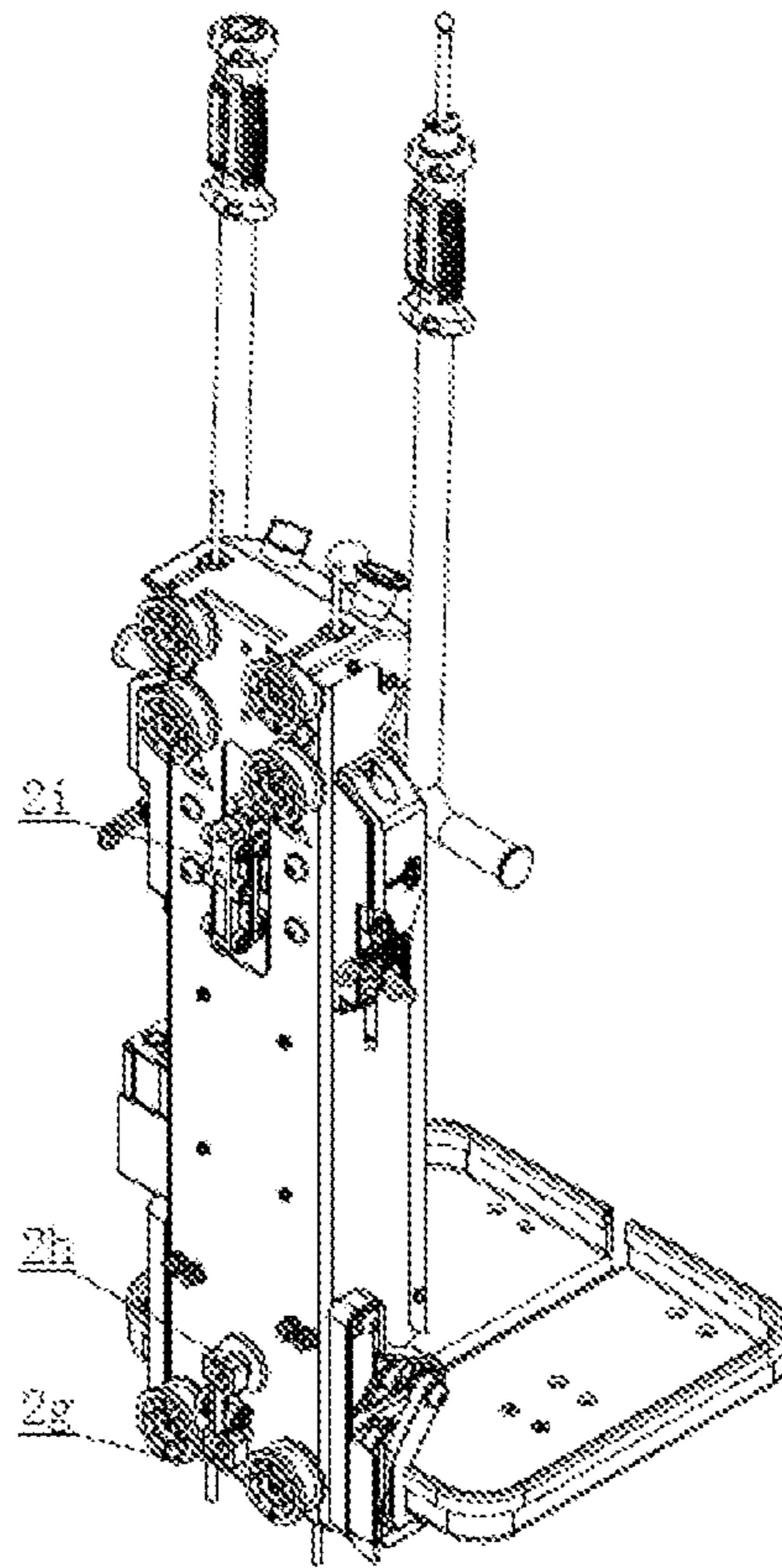


*Fig. 25*

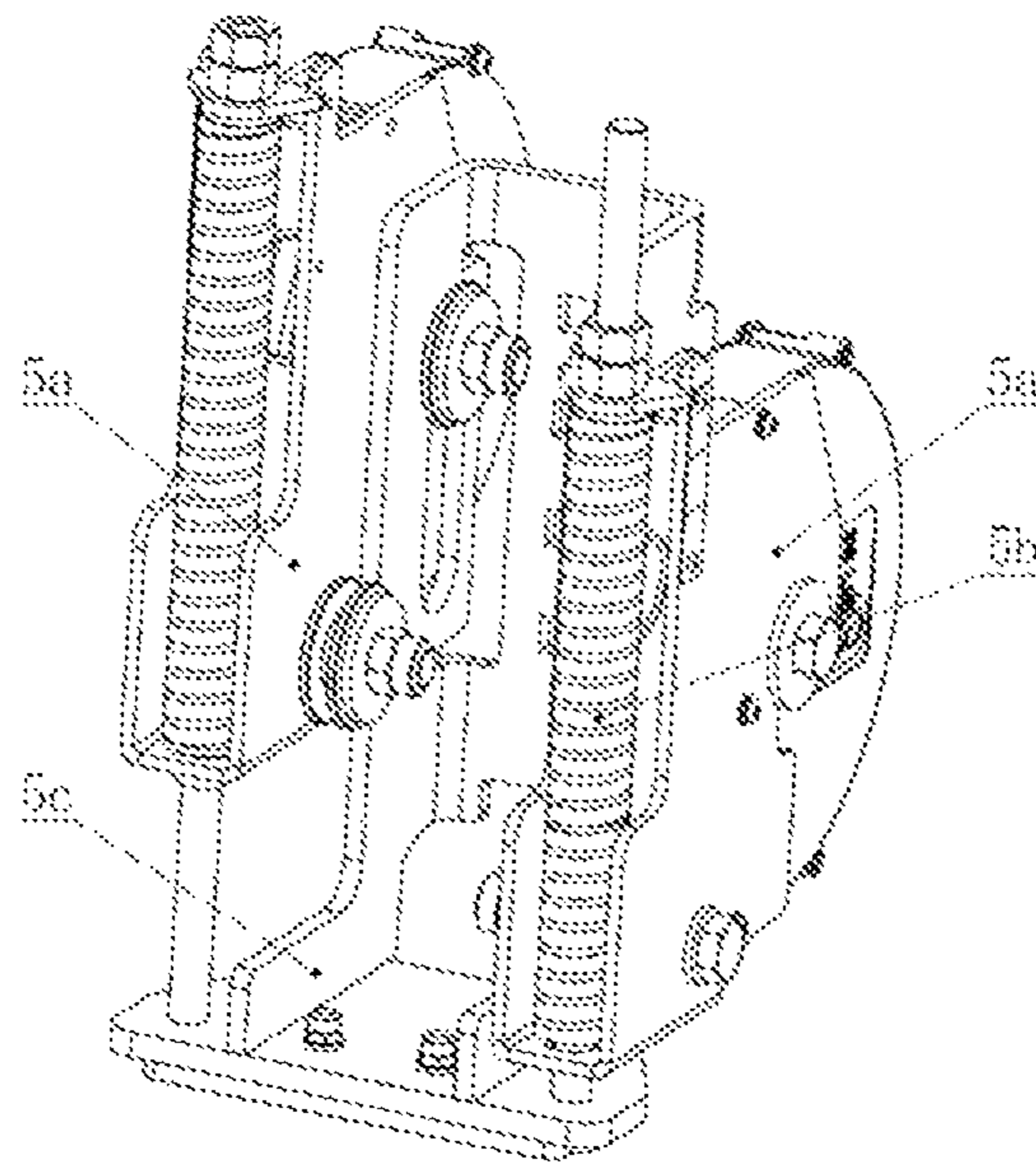




*Fig. 26*



*Fig. 27*



**Fig. 28**



**1****TRACTION MACHINE AND LIFTING  
EQUIPMENT**

## BACKGROUND

## Technical Field

The present application relates to the field of lifting equipment, and specifically to a traction machine and a lifting equipment.

## Description of the Related Art

The existing traction machine plays an important role in the ascending and descending of the lifting equipment. During the ascending of the lifting equipment, the power is mainly provided by the traction machine; while during the descending of the lifting equipment, the braking force is mainly provided by the traction machine to the lifting equipment.

During the operation, the existing traction machine may be in states where the fixed pulley is slipping, the traction rope is over-speed or the traction machine is not in operation, which will lead to that the lifting speed of the lifting equipment is not controlled. Therefore, it is necessary to provide a traction machine capable of monitoring the working state.

In addition, during the descending of the lifting equipment, in order to control the speed of the lifting equipment, the bus voltage of the controller of the traction machine will be changed, thereby affecting the stability of the controller.

## BRIEF SUMMARY

The present application aims to solve at least one of the technical problems existing in the prior art or the related art.

One of the objectives of the present application is to provide a traction machine and a lifting equipment to solve the technical problem existing in the prior art that once the traction machine is slipping, the traction rope is over-speed or the traction machine is not in operation, the lifting speed of the lifting equipment would not be controlled.

In order to achieve the objective, the present application provides a traction machine, including traction pulleys, traction ropes driven by the traction pulleys and fixed pulleys for changing directions of the traction ropes; wherein the fixed pulley is provided with a sensor sensing member rotating with the fixed pulley, a traction machine sensor is arranged beside the fixed pulley; the traction machine sensor is configured to detect a rotation speed of the sensor sensing member, and send the rotation speed to a controller of the traction machine; the controller controls a rotation of the traction pulley according to detected data of the traction machine sensor.

Since this kind of traction machine is provided with the sensor sensing member and the traction machine sensor, it is capable of detecting whether the traction machine has an abnormal operation, and stopping the traction machine in an abnormal state.

According to an embodiment of the present application, the controller of the traction machine is connected to the bus of the controller, and the bus of the controller is provided with a resistance module.

Since the resistance module is provided, when the bus voltage of the controller of the traction machine increases, the resistance module will automatically generate heat and convert the additional electric energy into the heat energy of

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the resistance module to be consumed, so that the bus voltage of the controller of the traction machine is maintained within a safe range.

The other objective of the present application is to provide a lifting equipment, including the traction machine above; wherein the lifting equipment further includes a climbing member, a guide rail and a lifting vehicle; the guide rail is arranged on the climbing member.

According to an embodiment of the present application, the guide rail is provided with a closing groove extending along a longitudinal direction of the guide rail, and an anti-falling device capable of ascending and descending along the guide rail is mounted on the lifting vehicle; the anti-falling device includes an anti-falling main body embedded in the closing groove; the anti-falling main body is provided with first rollers in the closing groove and capable of sliding along an inner wall of the closing groove; the anti-falling device further includes a second roller arranged at an opening of the closing groove and capable of sliding along the opening.

According to an embodiment of the present application, a number of the first rollers is at least two, and the first rollers are mounted on both sides of the anti-falling main body through a first roll shaft; the second roller is mounted to a front surface of the anti-falling main body through a second roll shaft, and the second roll shaft is perpendicular to the first roll shaft.

According to an embodiment of the present application, one side away from the closing groove of the second roller is provided with a wear plate; the second roll shaft is fixed to the lifting vehicle by sequentially penetrating through the anti-falling main body, the second roller, a first positioning sleeve and the wear plate; the wear plate is mounted to the second roll shaft through the first positioning sleeve.

According to an embodiment of the present application, a first elastic member capable of extending and retracting along a second roll shaft direction is arranged between the second roller and the anti-falling main body.

According to an embodiment of the present application, the second roller is connected to an upper portion of the anti-falling main body, and a lower portion of the anti-falling main body is provided with a second positioning sleeve; the second positioning sleeve is mounted to the front surface of the anti-falling main body through a third roll shaft which is parallel to the second roll shaft; and a second elastic member capable of extending and retracting along a length direction of the third roll shaft is arranged between the second positioning sleeve and the anti-falling main body.

According to an embodiment of the present application, the lifting equipment further includes a stall braking device mounted on the lifting vehicle; the stall braking device includes a speed-limiting assembly and a safety protection assembly.

According to an embodiment of the present application, the speed-limiting assembly includes a speed measuring wheel, a centrifugal block and a braking cam; the centrifugal block is fixed to the speed measuring wheel and rotates with the speed measuring wheel, and the centrifugal block satisfies: when a rotation speed of the speed measuring wheel is not less than a set speed, the centrifugal block opens and connects the braking cam so as to drive the braking cam to rotate.

According to an embodiment of the present application, the speed measuring wheel and the centrifugal block are fixedly mounted on a main shaft, and the speed measuring wheel drives the centrifugal block to rotate through the main shaft; the braking cam is fixedly mounted on a transmission



shaft, and the centrifugal block is connected to the transmission shaft through a transmission sleeve when opened.

According to an embodiment of the present application, the main shaft is provided with a first through hole in a radial direction; after a centrifugal spring passes through the first through hole, each of two ends of the centrifugal spring is fixed with a centrifugal block, respectively; lugs are formed on the main shaft, and the lug is provided with a second through hole extending axially along the main shaft; the centrifugal block is hinged to the second through hole through a pin shaft, so that the centrifugal block rotates with the second through hole as an axis and opens.

According to an embodiment of the present application, a first circumferential limiting member is formed on an outer surface of the centrifugal block, and a second circumferential limiting member is formed on an inner surface of the transmission sleeve; when the centrifugal block opens, the first circumferential limiting member and the second circumferential limiting member are circumferentially locked.

According to an embodiment of the present application, the outer surface of the centrifugal block includes two first involute surfaces, and the first circumferential limiting member is formed between the first involute surfaces; the inner surface of the transmission sleeve includes two second involute surfaces, and the second circumferential limiting member is formed between the second involute surfaces.

According to an embodiment of the present application, the safety protection assembly includes a locking block hinged on the lifting vehicle; and when the lifting vehicle operates normally, the locking block compresses a spring, and when the lifting vehicle stalls, the spring ejects the locking block so that the locking block is embedded in a locking hole of the guide rail.

According to an embodiment of the present application, one side facing the climbing member of the guide rail is provided with friction protrusions.

According to an embodiment of the present application, the top portion of the guide rail is mounted with guiding pulleys for the traction rope, and the bottom portion of the guide rail is provided with a tensioning device for the traction rope.

According to an embodiment of the present application, the lifting vehicle is connected to the traction rope, and the climbing member is provided with a traction rope protection assembly; the traction rope protection assembly includes idler rollers and a mounting bracket for mounting the idler rollers to the climbing member; a rotation direction of the idler roller is perpendicular to a lifting direction of the traction rope, and the idler rollers are between the climbing member and the traction rope.

According to an embodiment of the present application, a double-hand switch is provided on the lifting vehicle.

According to an embodiment of the present application, triggering blocks are arranged on the climbing member or the guide rail corresponding to places where space changes; when the lifting vehicle runs to the triggering block, the triggering block sends current position information to the controller, and the controller controls an operating speed of the lifting vehicle according to the position information.

#### BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

In order to more clearly illustrate the technical solutions of the embodiments of the present application or the prior art, a brief description of the drawings to be used in the embodiments or the description of the prior art will be made

hereinafter. Obviously, the drawings described below are only some embodiments of the present application, and those of ordinary skill in the art can obtain other drawings according to these drawings without any creative work.

FIG. 1 is a structural diagram of the traction machine according to an embodiment;

FIG. 2 is a mounting diagram of the sensor sensing member on the traction pulley according to an embodiment;

FIG. 3 is a perspective structural diagram of the anti-falling device according to an embodiment;

FIG. 4 is a sectional structural view of the anti-falling device according to an embodiment;

FIG. 5 is a top structural view of the speed-limiting assembly according to an embodiment;

FIG. 6 is a side structural view of the speed-limiting assembly according to an embodiment;

FIG. 7 is an exploded structural view of the speed-limiting assembly according to an embodiment;

FIG. 8 is a perspective structural diagram of the main shaft according to an embodiment;

FIG. 9 is a side structural view of the main shaft according to an embodiment;

FIG. 10 is a sectional structural view of A-A in FIG. 9.

FIG. 11 is a perspective structural diagram of the transmission sleeve according to an embodiment;

FIG. 12 is a side structural view of the transmission sleeve according to an embodiment;

FIG. 13 is a sectional structural view of B-B in FIG. 12.

FIG. 14 is a side structural view of the centrifugal block according to an embodiment;

FIG. 15 is a sectional structural view of C-C in FIG. 14.

FIG. 16 is a structural diagram of the braking cam according to an embodiment;

FIG. 17 is a structural diagram of the stall braking device according to an embodiment;

FIG. 18 is a partial structural diagram of the lifting equipment according to an embodiment;

FIG. 19 is a mounting diagram (I) of the safety protection assembly according to an embodiment;

FIG. 20 is a mounting diagram (II) of the safety protection assembly according to an embodiment;

FIG. 21 is a top structural view of the guide rail according to an embodiment;

FIG. 22 is a side structural view of the guide rail according to an embodiment;

FIG. 23 is structural diagram of the traction rope protection assembly according to an embodiment;

FIG. 24 is a structural diagram of the lifting equipment according to an embodiment;

FIG. 25 is a structural diagram (I) of the lifting vehicle according to an embodiment;

FIG. 26 is a structural diagram (II) of the lifting vehicle according to an embodiment;

FIG. 27 is a structural diagram (III) of the lifting vehicle according to an embodiment;

FIG. 28 is a structural diagram of the tensioning device according to an embodiment.

In the drawings: 1a, motor; 1b, speed reducer; 1c, traction pulley; 1d, pressing pulley; 1e, first fixed pulley; 1f, second fixed pulley; 1g, machine fixing frame; 1h, traction machine sensor; 1i, resistance module; 1j, machine shield; 1k, sensor sensing member; 2h, anti-falling device; 2i, safety protection assembly; 2h-1, wear plate; 2h-2, first roller; 2h-3, first roll shaft; 2h-4, anti-falling main body; 2h-5, third roll shaft; 2h-6, second positioning sleeve; 2h-7, second elastic member; 2h-8, second roller; 2h-9, first positioning sleeve; 2h-10, second roll shaft; 2i-1, safety protection main body; 2i-2,



## 5

safety protection assembly spring; 2i-3, safety protection assembly rotation shaft; 2i-4, locking block; 2i-5, safety protection assembly roller; 1, lifting vehicle; 2, stall braking device; 3, guide rail; 4, speed-limiting assembly; 5, fastener; 6, elastic cylindrical pin; 8, braking cam; 9, supporting side plate; 10, compression spring; 11, bearing; 12, return spring; 13, fixing bolt; 14, adjusting bolt; 15, top plate; 16, lug; 17, speed measuring wheel; 18, shaft elastic check ring; 19, centrifugal block; 20, centrifugal spring; 21, main shaft; 22, transmission sleeve; 23, cam half shaft; 24, bearing housing; 25, spacer; 26, limiting bolt; 27, first through hole; 28, second through hole; 29, pin hole; 30, first involute surface; 31, first limiting stair; 32, second involute surface; 33, second limiting stair; 01, traction machine; 03, controller; 04, first limiting device; 05, first fixed pulley assembly; 06, buffering device; 07, traction rope; 08, triggering block; 09, traction rope protection assembly; 011, second limiting device; 012, second fixed pulley assembly; 013, climbing member; 014, controller bus; 2a, platform anti-collision device; 2b, handle switch; 2c, limiting sensor; 2d, triggering plate; 2e, wireless transmitting device; 2f, battery; 2j, manual braking device; 2g, walking pulley; 5a, tensioning support; 5b, tensioning spring; 5c, guiding support; 9a, baffle; 9b, mounting bracket; 9c, idler roller; 010, friction protrusion.

## DETAILED DESCRIPTION

In order to more clearly understand the above objectives, features and advantages of the present application, the present application will be further described in detail hereinafter with reference to the drawings and specific embodiments. It should be noted that, the embodiments and the features therein of the present application may be combined with each other without conflict.

In the description of the present application, it should be noted that the orientational or positional relations indicated by the terms “central,” “longitudinal,” “lateral,” “upper,” “lower,” “front,” “rear,” “left,” “right,” “vertical,” “horizontal,” “top,” “bottom,” “inner,” “outer,” etc., are based on the orientational or positional relations shown in the drawings, and are only for the convenience of describing the present application and simplifying the description, but not indicating or implying that the indicated device or component must have the specific orientations, be constructed and operated in the specific orientations, which, therefore, cannot be construed as limiting the present application. In addition, the terms “first,” “second,” and “third” are for the descriptive purpose only and are cannot be construed as indicating or implying the relative importance.

In the description of the present application, it should be noted that unless specifically defined or limited otherwise, the terms “connect to” and “connect with” should be understood in a broad sense. For example, they may be fixed connections, removable connections, or integral connections; they may be mechanical connections or electrical connections; they may be direct connections or indirect connections through intermediate mediums. For the person of ordinary skill in the art, the specific meanings in the present application of the terms above can be understood according to the specific situations.

Referring to FIG. 1, the traction machine 01 of the present embodiment includes traction pulleys 1c, traction ropes 07 driven by the traction pulleys 1c and fixed pulleys for changing directions of the traction ropes 07. The fixed pulleys include first fixed pulleys 1e and second fixed pulleys 1f. The first fixed pulley 1e is provided with a sensor

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sensing member 1k rotating with the first fixed pulley 1e, a traction machine sensor 1h is arranged beside the first fixed pulley 1e; the traction machine sensor 1h is configured to detect the rotation speed of the sensor sensing member 1k, and send the rotation speed to a controller 03 of the traction machine 01. The controller 03 controls the rotation of the traction pulley 1c according to the detected data of the traction machine sensor 1h.

Since the traction machine 01 of the present application is provided with the sensor sensing member 1k and the traction machine sensor 1h, it is capable of detecting whether the traction machine 01 has an abnormal operation, and stopping the traction machine 01 in an abnormal state.

According to one of the embodiments of the present application, when the traction pulley 1c drives the traction rope 07 to move, the traction rope 07 simultaneously drives the fixed pulleys to rotate, and the sensor sensing member 1k rotates with the first fixed pulley 1e. Each time the sensor sensing member 1k rotates with the fixed pulleys, the traction machine sensor 1h contacts it once, and sends a signal to the controller 03 of the traction machine 01, so that the controller 03 determines the rotation speed of the fixed pulleys and compares it with the rotation speed of the traction pulley 1c, thereby determining whether the movement speed of the traction rope 07 meets the setting requirements. When an abnormal operation occurs, the controller 03 of the traction machine 01 stops the operation of the traction machine 01.

According to one of the embodiments of the present application, the controller 03 of the traction machine 01 is connected to the bus of the controller 03, and the bus of the controller 03 is provided with a resistance module 1i.

The function of the resistance module 1i of the traction machine 01 is illustrated by taking a lifting equipment provided with this kind of traction machine 01 as an example:

When the lifting vehicle of the lifting equipment is descending, the controller 03 of the traction machine 01 drives the traction pulley 1c of the traction machine 01 to descend with the potential energy load, and the motor 1a of the traction machine 01 is in a regenerating braking state (power generation state). The regenerated electric energy is rectified by the controller 03 of the traction machine 01 and fed back to the bus of the controller 03. The voltage of the bus of the controller 03 continues to rise with the descending of the lifting vehicle, thereby adversely affecting or damaging the controller 03. In the present embodiment, when the bus voltage of the controller 03 of the traction machine 01 increases, since the bus of the controller 03 is connected with the resistance module 1i, the resistance module 1i will automatically generate heat and convert the additional electric energy into the heat energy of the resistance module 1i to consume, so that the bus voltage of the controller 03 of the traction machine 01 is maintained within a safe range.

According to one of the embodiments of the present application, the traction machine 01 includes a motor 1a and a speed reducer 1b. The motor 1a and the speed reducer 1b can be fixedly mounted by bolts. The speed reducer 1b and a machine fixing frame 1g can be bolted together. The traction pulleys 1c can be mounted to output shafts on both sides of the speed reducer 1b by bolts and gaskets. Pressing pulleys 1d can be fixed to both sides of the speed reducer 1b by bolts. Below the traction pulley 1c, the pressing pulley 1d presses the traction rope 07 into a pulley groove of the traction pulley 1c, so as to avoid the sliding between the traction rope 07 and the traction pulley 1c. The sensor sensing member 1k is mounted on the first fixed pulley 1e.



In FIG. 1, the fixed pulleys include the first fixed pulley 1e and the second fixed pulley 1f. Of course, the number and arrangement of the fixed pulley are not limited by the examples herein. Wherein, the first fixed pulleys 1e are mounted to upper portions of both sides of the machine fixing frame 1g (in FIG. 1, only one side of the machine fixing frame 1g can be seen, and the other side of the machine fixing frame 1g is also mounted with a fixed pulley). The traction machine sensor 1h is mounted on the machine fixing frame 1g at a position corresponding to the sensor sensing member 1k. The “corresponding” herein takes that the rotation speed change of the sensor sensing member 1k can be detected as a standard. The numbers and arrangements of the traction machine sensor 1h and the sensor sensing member 1k are not limited by the examples herein. The first fixed pulley 1e rotates to drive the sensor sensing member 1k to rotate to trigger the traction machine sensor 1h, so as to detect whether the traction rope 07 is slipping or whether the operating speed is normal through the controller 03. The second fixed pulleys 1f are mounted to lower portions of both sides of the machine fixing frame 1g and function as steering the traction rope 07. The resistance module 1i is mounted into the machine fixing frame 1g. Finally, a machine shield 1j is mounted on the machine fixing frame 1g to enclose the first fixed pulleys 1e, the second fixed pulleys 1f, the traction pulleys 1c and the pressing pulleys 1d within the machine shield 1. The machine shield 1j plays a protective role to prevent safety hazards when the traction machine 01 is operating.

One of the structures of the sensor sensing member 1k is shown in FIG. 2. Of course, the sensor sensing member 1k in FIG. 2 does not constitute a limitation to the present application.

In addition, the present embodiment also provides a lifting equipment, including the traction machine 01 above. In addition, the lifting equipment of the present embodiment further includes a climbing member, a guide rail and a lifting vehicle. The guide rail is arranged on the climbing member.

According to one of the embodiments of the present application, the traction machine 01 is fixed to the guide rail by bolts penetrating through mounting holes of the guide rail. The form of the mounting hole is not limited, and for example, rectangular holes may be employed. The mounting position of the traction machine 01 can be adjusted as needed along a vertical direction of the guide rail. The traction machine 01 drives the traction pulleys 1c to rotate by the motor 1a and the speed reducer 1b, thereby driving the traction ropes 07 to move up and down, so as to achieve the ascending and descending of the lifting vehicle.

Wherein, the guide rail has rectangular holes or waist-round holes on a fixed plane. The rectangular holes or the waist-round holes are arranged at equal intervals along the length direction of the guide rail. The guide rail is mounted at the place where the lifting equipment operates, such as a climbing member in a fan tower, an electric power tower, a chimney and other buildings. The guide rail is fixed to the climbing member, the electric power tower, the chimney and other buildings above by bolts penetrating through the rectangular holes or waist-round holes of the guide rail. Wherein the fixed plane of the guide rail has protrusions, and the shape of the protrusion may be a triangle, a trapezoid, a rectangle or a circular arc, etc. The protrusions are arranged for increasing the fixing strength of the guide rail when the guide rail is fixed.

The guide rail is provided with a closing groove extending along the longitudinal direction of the guide rail, and an

anti-falling device 2h capable of ascending and descending along the guide rail is mounted on the lifting vehicle.

According to one of the embodiments of the present application, the structure of the anti-falling device 2h is shown in FIG. 3 and FIG. 4. In FIG. 3 and FIG. 4, the anti-falling device 2h includes an anti-falling main body 2h-4 embedded in the closing groove. The anti-falling main body 2h-4 is provided with first rollers 2h-2 in the closing groove and capable of sliding along the inner wall of the closing groove. The anti-falling device 2h also includes a second roller 2h-8 arranged at the opening of the closing groove and capable of sliding along the opening. It is apparent that the numbers and distributions of the first roller 2h-2 and the second roller 2h-8, and the structure of the anti-falling main body 2h-4 are not limited by the drawings.

Herein, the second roller 2h-8 slides along the opening, that is, the second roller 2h-8 slides along the side wall of the opening, therefore the side wall of the opening serves as guiding and limiting functions for the second roller 2h-8.

In one case, the number of the first rollers 2h-2 is at least two, and the first rollers 2h-2 are mounted on both sides of the anti-falling main body 2h-4 through a first roll shaft 2h-3. The second roller 2h-8 is mounted to the front surface of the anti-falling main body 2h-4 through the second roll shaft 2h-10, and the second roll shaft 2h-10 is perpendicular to the first roll shaft 2h-3. Wherein, the orientation of the anti-falling main body 2h-4 is determined based on the state in which the anti-falling main body 2h-4 is mounted to the lifting equipment.

In this case, by providing the first rollers 2h-2 and the second roller 2h-8, the lifting vehicle can ascend and descend along the guide rail. Meanwhile, since the first rollers 2h-2 are arranged in the closing groove, the lifting vehicle can be prevented from derailing.

Further, one side away from the closing groove of the second roller 2h-8 is provided with a wear plate 2h-1. Therefore, by the cooperation of the wear plate 2h-1 and the second roller 2h-8, the operation stability of the lifting vehicle along the guide rail can be further ensured so as to prevent the lifting vehicle from derailing.

In FIG. 3 and FIG. 4, the second roll shaft 2h-10 may be fixed to the lifting vehicle by a bolt sequentially penetrating through the anti-falling main body 2h-4, the second roller 2h-8 and the wear plate 2h-1. Further, in order to prevent the direct contact between the wear plate 2h-1 and the guide rail, and to protect the lifting vehicle, the wear plate 2h-1 is mounted to the second roll shaft 2h-10 through a first positioning sleeve 2h-9, thereby leaving a certain gap between the lifting vehicle and the wear plate 2h-1, and a certain gap between the wear plate 2h-1 and the second roller 2h-8. The wear plate 2h-1 may have a round shape, and the diameter of the wear plate 2h-1 is greater than the width of the opening, so that the wear plate 2h-1 and the first roller 2h-2 are respectively located inside and outside the closing groove. And the second roller 2h-8 is limited at the opening by the wear plate 2h-1 and the first rollers 2h-2.

In addition, a first elastic member capable of extending and retracting along the second roll shaft 2h-10 direction is arranged between the second roller 2h-8 and the anti-falling main body 2h-4. By the arrangement of the first elastic member, the problem of the stuck operation of the lifting vehicle caused by the misalignment of the guide rail can be avoided. The first elastic member herein can be a disc spring, and the number of the disc spring may be plural. For example, two disc springs may be arranged between the second roller 2h-8 and the anti-falling main body 2h-4.



The second roller **2h-8** of the present embodiment may be plural and distributed up and down along the height direction of the anti-falling main body **2h-4**. Of course, as shown in FIG. 3 and FIG. 4, the second roller **2h-8** may also be connected to the upper portion of the anti-falling main body **2h-4**, and the lower portion of the anti-falling main body **2h-4** may be provided with a second positioning sleeve **2h-6**. The second positioning sleeve **2h-6** is mounted to the front surface of the anti-falling main body **2h-4** through a third roll shaft **2h-5** which is parallel to the second roll shaft **2h-10**. Wherein, the lifting vehicle can be prevented from directly contacting the guide rail by providing the second positioning sleeve **2h-6**, thereby maintaining the stable structural relation between the lifting vehicle and the guide rail.

Similarly, in order to prevent the lifting vehicle from being stuck, a second elastic member **2h-7** capable of extending and retracting along the length direction of the third roll shaft **2h-5** is arranged between the second positioning sleeve **2h-6** and the anti-falling main body **2h-4**. The structure and form of the second elastic member **2h-7** is also not limited. The third roll shaft **2h-5** herein may also be a bolt, so that the anti-falling device **2h** can be fixed to the lifting vehicle by the bolt penetrating through the anti-falling main body **2h-4** and the second positioning sleeve **2h-6** sequentially.

The specific forms of the first rollers **2h-2** and the second roller **2h-8** are not limited. For example, they may be both in the form of bearings, or ordinary runners, as long as the anti-falling device **2h** can be rolled along the guide rail.

According to one of the embodiments of the present application, the lifting equipment further includes a stall braking device. Specifically, the vehicle body of the lifting vehicle is equipped with the stall braking device, and in the case of stall or the traction rope **07** being broken, the lifting vehicle is quickly locked on the guide rail, thereby achieving the operation stop of the lifting vehicle which will not fall. The stall braking device includes a speed-limiting assembly **4** and a safety protection assembly **2i**.

According to one of the embodiments of the present application, as shown in FIG. 5 and FIG. 6, the speed-limiting assembly **4** of the present embodiment includes a speed measuring wheel **17**, a centrifugal block **19** and a braking cam **8**. Wherein, the centrifugal block **19** is fixed to the speed measuring wheel **17** and rotates with the speed measuring wheel **17**, and the centrifugal block **19** satisfies: when the speed of the speed measuring wheel **17** is not less than a set speed, the centrifugal block **19** opens and connects the braking cam **8** so as to drive the braking cam **8** to rotate.

Herein, the connection between the centrifugal block **19** and the braking cam **8** may be either a direct connection or an indirect connection.

The speed-limiting assembly **4** of the present embodiment is fixed to the lifting vehicle **1**, and when the speed-limiting assembly **4** is mounted on the guide rail **3**, the speed measuring wheel **17** can measure and obtain the lifting speed of the lifting vehicle **1**. Once the rotation speed of the speed measuring wheel **17** is not less than the set speed, it indicates that the lifting speed of the lifting vehicle **1** exceeds the safety limit. At this time, the centrifugal block **19** opens to drive the braking cam **8** to rotate, so as to achieve the direct speed limit or braking for the lifting vehicle **1**. The speed-limiting assembly **4** can avoid the hazard caused by the connection failure between the lifting vehicle **1** and the traction rope **07**, and the risk of the tilting of the lifting vehicle **1**.

As shown in FIG. 7, in the speed-limiting assembly **4** of the present embodiment, the speed measuring wheel **17** and the centrifugal block **19** are fixedly mounted on a main shaft **21**, and the speed measuring wheel **17** drives the centrifugal block **19** to rotate through the main shaft **21**. Of course, in addition to that the centrifugal block **19** is fixed to the speed measuring wheel **17** by the main shaft **21**, the centrifugal block **19** can be directly connected to the speed measuring wheel **17** by a centrifugal spring **20**, or can be connected to the speed measuring wheel **17** by any means disclosed in the prior art.

In addition, the braking cam **8** is fixedly mounted on a transmission shaft, and the centrifugal block **19** is connected to the transmission shaft through a transmission sleeve **22** when opened. Therefore, when the rotation speed of the speed measuring wheel **17** is not less than the set speed, the centrifugal block **19** can drive the transmission shaft to rotate through the transmission sleeve **22**, thereby driving the braking cam **8** to perform braking.

Of course, the connection between the centrifugal block **19** and the transmission shaft is not necessary through the transmission sleeve **22**. Any connection that allows the transmission between the centrifugal block **19** and the transmission shaft can be applied between the centrifugal block **19** and the transmission shaft.

And the braking cam **8** does not have to be connected to the transmission shaft. For example, the centrifugal block **19** can also be directly connected to the braking cam **8**, that is, when the centrifugal block **19** opens, it directly contacts the braking cam **8** and drives the braking cam **8** to rotate.

As shown in FIG. 8 to FIG. 10, the main shaft **21** of the present embodiment is provided with a first through hole **27** in a radial direction. After the centrifugal spring **20** passes through the first through hole **27**, each of the two ends of the centrifugal spring **20** is fixed with a centrifugal block **19**, respectively. In this case, when the rotation speed of the main shaft **21** is in a safe range, the two centrifugal blocks **19** tightly hold the main shaft **21** under the action of the centrifugal spring **20**. Once the rotation speed of the main shaft **21** exceeds the safe range, the two centrifugal blocks **19** are opened by the centrifugal force. Wherein, the centrifugal block **19** can, but do not have to, be fixed to the centrifugal spring **20** by a pin shaft. Since two centrifugal blocks **19** are connected by one centrifugal spring **20**, it not only simplifies the structure, but also ensures that the main shaft **21** is balanced by force so as to prevent the main shaft **21** from being eccentric.

Referring further to FIG. 8, lugs **16** can be formed on the main shaft **21**, and the lug **16** is provided with a second through hole **28** extending axially along the main shaft **21**. When the centrifugal block **19** is connected to the centrifugal spring **20** by the pin shaft, it can be further hinged to the lug **16** through the pin shaft. For example, a clearance fit can be used between the pin shaft and the second through hole **28**, so that the centrifugal block **19** can rotate around the second through hole **28** with the pin shaft as a rotating shaft. The pin shaft herein can be an elastic cylindrical pin **6**.

In this case, different centrifugal blocks **19** are all rotated relative to the second through holes **28** on the main shaft **21**, and open as the centrifugal blocks **19** rotate. Since the centrifugal block **19** is not wholly away from the main shaft **21** by centrifugation, but one end is hinged to the lug **16** on the main shaft **21** and the other end is rotated by the centrifugal force, this kind of centrifugal block **19** can achieve a more precise control. In addition, since the connecting line of the two second through holes **28** on the lugs **16** radially coincides with the main shaft **21**, the two



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centrifugal blocks 19 which rotate around the second through holes 28 will not generate an eccentric force to the main shaft 21.

It can be seen from FIG. 10 that, the angle between the first through hole 27 and the connecting line of the two second through holes 28 is less than 90°, therefore the rotation radius of the centrifugal block 19 rotating around the second through hole 28 can be reduced.

In addition, when the centrifugal block 19 drives the braking cam 8 to rotate through the transmission sleeve 22, a first circumferential limiting member may be formed on the outer surface of the centrifugal block 19, and a second circumferential limiting member is formed on the inner surface of the transmission sleeve 22. Therefore, when the centrifugal block 19 opens, the first circumferential limiting member and the second circumferential limiting member are circumferentially locked, so that the centrifugal block 19 can drive the transmission sleeve 22 to rotate, thereby driving the braking cam 8 to perform braking. Of course, in addition to that the transmission between the centrifugal block 19 and the transmission sleeve 22 is achieved by the limiting members (that is, the first circumferential limiting member and the second circumferential limiting member), the transmission can also be achieved by friction fit or any means disclosed in the prior art.

The structure of the transmission sleeve 22 of the present embodiment is shown in FIG. 11 to FIG. 13. The outer surface of the centrifugal block 19 includes two first involute surfaces 30, and the first circumferential limiting member is formed between the first involute surfaces 30. The structure of the centrifugal block 19 of the present embodiment is shown in FIG. 14 and FIG. 15. The inner surface of the transmission sleeve 22 includes two second involute surfaces 32, and the second circumferential limiting member is formed between the second involute surfaces 32. The fitting surface between the centrifugal block 19 and the transmission sleeve 22 uses the involute surface design, so that an effective fit between the centrifugal block 19 and the transmission sleeve 22 is ensured, which is advantageous for achieving the circumferential locking between the first circumferential limiting member and the second circumferential limiting member when the centrifugal block 19 rotates, preventing the ineffective interference between the centrifugal block 19 and the transmission sleeve 22.

Wherein, it is preferable but not necessary that: the first circumferential limiting member is a first limiting stair 31, and the second circumferential limiting member is a second limiting stair 33. Such limiting fit is simple and reliable.

In addition, in FIG. 7, the transmission shaft is a cam half shaft 23, so that the centrifugal block 19 needs to drive the cam half shaft 23 to rotate through the transmission shaft 22. The end of the cam half shaft 23 extends out toward the transmission sleeve 22 with connecting pins, and the transmission sleeve 22 is provided with pin holes 29, so that the connecting pins extend into the pin holes 29 of the transmission sleeve 22. In order to ensure the stress is balanced, a plurality of connecting pins, for example four connecting pins, are evenly distributed at the end of the transmission shaft. Of course, the connection manner between the cam half shaft 23 and the transmission sleeve 22 is not limited by the example herein, as long as the transmission sleeve 22 can drive the cam half shaft 23 to rotate.

As shown in FIG. 16, the braking cam 8 includes four third involute surfaces that are smoothly butted, so as to achieve the gradual increase in the braking pressure of the

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brake cam 8. In this case, the braking cam 8 is easy to manufacture and can adjust the pressing degree during the pressing process.

Referring further to FIG. 5 to FIG. 7, the speed-limiting assembly 4 of the present embodiment also includes fixed baffles and a bearing housing 24. Wherein, the fixed baffles include two supporting side plates 9 parallel to each other, and a top plate 15 for connecting the two supporting side plates 9; the bearing housing 24 is mounted between the supporting side plates 9 and the top plate 15, including a first bearing housing 24 and a second bearing housing 24. The first bearing housing 24 is configured to fix a bearing 11 of the main shaft 21, the second bearing housing 24 is configured to fix a bearing 11 of the transmission shaft. The speed measuring wheel 17 and the braking cam 8 are respectively located on the outer sides of the two supporting side plates 9.

Wherein, the two supporting side plates 9, as well as the top plate 15 and the supporting side plates 9 are fixedly connected through fasteners 5. Herein, the fastener 5 may be a bolt. As another example, the fastener 5 may be used to mount the speed-limiting assembly 4 of the present embodiment on the lifting equipment mentioned below.

In addition, in order to limit the rotation angle of the braking cam 8, the limiting assembly further includes a limiting bolt 26 that can cooperate with the braking cam 8 and prevent the further rotation of the braking cam 8.

In this case, the fixed baffles can not only isolate and protect the transmission members (including the main shaft 21, the transmission shaft, the centrifugal block 19 and the transmission sleeve 22, etc.) on the inner side thereof, but also fix the main shaft 21 and the transmission shaft by mounting the bearing housing 24.

In addition, in order to achieve a reliable mounting of the speed measuring wheel 17, the speed measuring wheel 17 is connected to the main shaft 21 via a shaft elastic check ring 18. That is, the shaft elastic check ring 18 is provided on the outer side of the speed measuring wheel 17, and the shaft elastic check ring 18 is clamped on the main shaft 21.

Wherein, it can be seen from FIG. 6 and FIG. 7 that, the transmission shaft and the top plate 15 are connected through a return spring 12. Therefore, an automatic restoration of the braking cam 8 can be achieved by the return spring 12. Wherein, a first end of the return spring 12 can be fixed to the top plate 15 by a fixing bolt 13, and a second end of the return spring 12 can be directly fixed to the outer peripheral surface of the cam half shaft 23.

The bottom end of the bearing housing 24 is mounted on the supporting side plate 9 through a spacer 25 so as to ensure the mounting reliability of the bearing housing 24.

The top end of the bearing housing 24 is elastically connected to the top plate 15 by an elastic member. In this case, the mounting position of the bearing housing 24 can be adjusted through the elastic member so as to achieve the position adjustment of the speed measuring wheel 17. For example, when the speed-limiting assembly 4 is mounted between the guide rail 3 and the lifting vehicle 1 of the lifting equipment, the speed measuring wheel 17 is always reliably moving along the guide rail 3 by adjusting the position of the bearing housing 24.

Wherein, a compression spring 10 can be connected to the top end of the bearing housing 24, and an adjusting bolt 14 extending toward the compression spring 10 is fixed to the top plate 15, and the adjusting bolt 14 at least partially extends into the compression spring 10. The compression spring 10 and the adjusting bolt 14 herein constitute the elastic member between the bearing housing 24 and the top



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plate 15 above. The compression spring 10 can be compressed or released by the adjusting bolt 14, thereby adjusting the position of the bearing housing 24.

The stall braking device 2 of the present embodiment is shown in FIG. 17. The mounting of the stall braking device 2 is shown in FIG. 18. The mounting of the speed-limiting assembly 4 satisfies: the speed measuring wheel 17 rolls along the guide rail 3, and when the centrifugal block 19 opens, the braking cam 8 rotates and press the guide rail 3.

Since the stall braking device 2 is directly mounted on the lifting vehicle 1 so that the lifting vehicle 1 is immediately stopped running when it exceeds the safe speed, the lifting equipment of the present embodiment is safe and reliable, and can reduce the risk when the stalling control is performed by the traction rope 07, and does not face the danger of tilting when the lifting vehicle 1 is locked, and reduces the impact and damage to the lifting equipment.

In addition, the stall braking device 2 further includes a safety protection assembly 2i fixed to the speed-limiting assembly 4. Therefore, the safety protection assembly 2i can prevent the lifting vehicle 1 from suddenly descending and falling along the guide rail 3.

It can be seen from FIG. 18 that, the supporting side plate 9 of the speed-limiting assembly 4 is connected to the safety protection assembly 2i by a pin shaft. Similarly, the pin shaft herein can be an elastic cylindrical pin 6.

As shown in FIG. 19 and FIG. 20, the safety protection assembly 2i of the present embodiment includes a locking block 2i-4 hinged on the lifting vehicle. When the lifting vehicle operates normally, the locking block 2i-4 compresses a spring, and when the lifting vehicle stalls, the spring ejects the locking block 2i-4 so that the locking block 2i-4 is embedded in a locking hole of the guide rail.

According to one of the embodiments of the present application, the locking block 2i-4 is mounted to a safety protection main body 2i-1 through the safety protection assembly with a rotation shaft 2i-3. One end of the safety protection assembly spring 2i-2 is mounted to the safety protection main body 2i-1, the other end is mounted to the locking block 2i-4 so as to generate a certain elastic force to the locking block 2i-4. The safety protection assembly is mounted to the safety protection main body 2i-1 with a roller 2i-5 so as to ensure that the safety protection assembly 2i can smoothly slide in the guide rail.

According to one of the embodiments of the present application, the safety protection assembly 2i can be mounted on a lifting vehicle support by a bolt penetrating through a round hole of the locking block 2i-4. The waist-shaped hole on the lifting vehicle support ensures that the safety protection assembly 2i can move relative to the lifting vehicle within a certain range. When the lifting vehicle is operating, under the weight of the safety protection main body 2i-1 and the action of the lifting vehicle support, the bolted end of the locking block 2i-4 is lifted relative to the safety protection main body 2i-1, and the other end of the locking block 2i-4 is substantially flush with the safety protection main body 2i-1 and presses the spring, so that the safety protection assembly 2i moves uniformly with the lifting vehicle in the guide rail, as shown in FIG. 19. When the traction rope 07 breaks and the lifting vehicle falls, the safety protection assembly 2i is moving with the lifting vehicle, and the supporting force of the lifting vehicle support for the locking block 2i-4 disappears, the locking block 2i-4 of the safety protection assembly 2i is ejected and locked in a locking hole of the guide rail due to the elastic force of the spring, as shown in FIG. 20, so that the locking

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of the lifting vehicle when it is falling is achieved, and the safety of life and property of the equipment and personnel are ensured.

According to one of the embodiments of the present application, the lifting equipment is further provided with a manual braking device 2j. The manual braking device 2j is mounted on the upper portion of the lifting vehicle, and one end of the manual braking device 2j is connected to the safety protection assembly 2i. When the equipment is falling and not locked, the safety protection assembly 2i can be forced to be locked in the locking holes of the guide rail by pulling the manual braking device 2j, so as to ensure the safety of operating personnel. Wherein, the locking hole can be a rectangular hole.

The structure of the guide rail of the present embodiment is shown in FIG. 21 and FIG. 22. The side facing the climbing member of the guide rail is provided with friction protrusions 010, which can be selected as triangular protrusions, thereby ensuring the mounting reliability of the guide rail on the climbing member.

According to one of the embodiments of the present application, the top portion of the guide rail is mounted with guiding pulleys for the traction rope 07, and the bottom portion of the guide rail is provided with a tensioning device for the traction rope 07. The structure of the tensioning device is shown in FIG. 28. Tensioning pulleys are provided in the tensioning device.

The guiding pulleys and the tensioning pulleys are fixed at the top portion and bottom portion of the guide rail respectively. There are two guiding pulleys and two tensioning pulleys respectively, each of the left side and right side of the guide rail is provided with a guiding pulley and a tensioning pulley. Wherein, the tensioning pulleys at the bottom portion can move along the guide rail within a certain range, and the tensioning device is further provided with a tensioning spring 5b and a guiding support 5c. A tensioning support 5a can move relative to the guiding support 5c, so as to drive the tensioning pulley to move up and down to adjust the tensioning force of the traction rope 07.

Due to the different site environments, the guide rail will have different degrees of inclination after mounting, and because the position of the traction rope 07 is determined by the guiding pulleys and the tensioning pulleys, the traction rope 07 may have frictions and scratches with the climbing member etc., mounted on the chimney, tall building, tower silo, ropeway pole, transmitting antenna, wind power generator, high-voltage tower and crane or the similar objects on site, affecting the life of the traction rope 07. At the same time, the traction rope 07 will cause damages to the climbing member etc., mounted on the chimney, tall building, tower silo, ropeway pole, transmitting antenna, wind power generator, high-voltage tower and crane or the similar objects on site. In order to solve the problem, traction rope protection assemblies 09 are fixed on the guide rail of the lifting equipment for holding up the traction rope 07, so as to avoid the frictions and scratches on the climbing member etc., mounted on the chimney, tall building, tower silo, ropeway pole, transmitting antenna, wind power generator, high-voltage tower and crane or the similar objects. In one of the cases, the climbing member is a ladder.

In addition, the types of the lifting equipment include elevators, cranes, climbing-free devices, etc., and are not limited by the examples herein.

As shown in FIG. 23, the traction rope protection assembly 09 includes idler rollers 9c and a mounting bracket 9b for mounting the idler rollers 9c to the climbing member. The



rotation direction of the idler roller **9c** is perpendicular to the lifting direction of the traction rope **07**, and the idler rollers **9c** are between the climbing member and the traction rope **07**. Wherein, the idler rollers can rotate freely on the mounting bracket **9b**. The number of the idler rollers **9c** may be two or more, and the idler rollers **9c** are symmetrically distributed on both sides of the guide rail to protect the traction ropes **07** on both sides of the guide rail.

Wherein, the traction rope protection assembly **09** may further include baffles **9a** on both sides of the idler roller **9c** and the mounting bracket **9b** for protecting the idler roller **9c** and the mounting bracket **9b**. The mounting of the traction rope protection assembly **09** is shown in FIG. **24**.

Referring to FIG. **24** again, according to one of the embodiments of the present application, buffering devices **06** are mounted on the top portion and the bottom portion of the guide rail respectively. The buffering device **06** may include a fixed plate and a buffering block mounted on the top portion and the bottom portion of the guide rail respectively for preventing the lifting vehicle from departing from the lifting vehicle, and buffering and the absorbing the energy when the lifting vehicle is suffering impacts.

Referring to FIG. **24** again, according to one of the embodiments of the present application, triggering blocks **08** are arranged on the corresponding climbing member or guide rail at the places where space changes. When the lifting vehicle runs to the triggering block **08**, the triggering block **08** sends the current position information to the controller **03**, and the controller **03** controls the operating speed of the lifting vehicle according to the position information.

In addition, a first fixed pulley assembly **05** and a second fixed pulley assembly **012** are provided on both ends of the guide rail respectively.

The structure of the lifting vehicle is shown in FIG. **25** to FIG. **27**.

According to one of the embodiments of the present application, a double-hand switch is provided on the lifting vehicle, and both hands are needed to simultaneously operate to start up the lifting equipment, thereby restraining the positions of the hands when the operator is operating the lifting vehicle, avoiding the accidental scratching to the operator due to the open running channel. Wherein, the double-hand switch is the form of the handle switches **2b**.

Specifically, each of the two handles of the lifting vehicle is provided with a handle switch **2b**. The operator needs to simultaneously hold the handle switches **2b** to operate the equipment, restraining the operator operating the lifting vehicle with both hands on the lifting vehicle, so as to prevent the operator from operating the equipment with one hand and the other hand extending out of the lifting vehicle to cause accidental scratching.

According to one of the embodiments of the present application, the lifting equipment is provided with a platform anti-collision device **2a**. The platform anti-collision device **2a** is mounted on one of the two handle switches **2b**. When the lifting vehicle runs upward and the platform anti-collision device **2a** encounters an obstacle, the lifting equipment automatically stops so as to prevent the equipment from damage.

According to one of the embodiments of the present application, a limiting sensor **2c** is provided on each of the left side and the right side of the lifting vehicle respectively. The limiting sensor **2c** on the left side cooperates with a second limiting device **011** to achieve the upper limit function; the limiting sensor **2c** on the right side cooperates with the triggering block **08** to achieve the position recog-

ognition function. Wherein the second limiting device **011** is mounted on the bottom portion of the guide rail to achieve the lower limit function. Wherein, since the bottom portion of the guide rail has electrical signals, there is no need to additionally provide a sensor matching with the second limiting device **011**.

The first limiting device **04** and the second limiting device **011** are also respectively fixed on the top portion and the bottom portion of the guide rail, and the first limiting device **04** and the second limiting device **011** are higher than the tensioning pulleys at the bottom portion and lower than the guiding pulleys at the top portion. When the lifting vehicle runs to the limiting device (the first limiting device **04** or the second limiting device **011**), the limiting switch will be triggered.

According to one of the embodiments of the present application, the lifting equipment is provided with a wireless transmitting device **2e**. When the limiting switches above are triggered, the wireless transmitting device **2e** transmits a signal to the controller **03**, and the controller **03** stops the operation of the traction machine **01**.

According to one of the embodiments of the present application, several sets of walking pulleys **2g** are mounted on the upper portion and the lower portion of the back side of the lifting vehicle, and the arc concave surface of the walking pulley **2g** holds the arc convex surfaces on both sides of the guide rail to ensure the movement of the lifting vehicle along the guide rail. The walking pulley **2g** can be made of non-metallic material to avoid the wear on the guide rail by the long-term operation.

In addition, in the case that the lifting vehicle is provided with the wireless transmitting device **2e**, the wireless transmitting device **2e** collects various signals during the operation of the lifting vehicle, such as the signal of the handle switch **2b**, the signal of the limiting sensor **2c**, the signal of the platform anti-collision device **2a**, the signal of the triggering block **08**, etc., and the signals are transmitted to the controller **03** by the wireless transmitting device **2e**, so that the controller **03** sends action commands to the traction machine **01** by determining the signals. The wireless transmitting device **2e** can be mounted in the lifting vehicle.

The wireless transmitting device **2e** of the lifting vehicle may include a warning module, so that when the lifting vehicle runs to the triggering block **08**, the warning module automatically issues a warning sound to remind the operator of the position change of the lifting vehicle.

In addition, the lifting vehicle may also be provided with a battery **2f** which can be mounted in a battery box on the side of the lifting vehicle, and the battery **2f** can supply power to the wireless transmitting device **2e**.

The embodiments above are only for illustrating the present application, and not intended to limit the present application. Although the present application has been described in detail with reference to the embodiments, the person of ordinary skill in the art should understand that, various combinations, modifications, and equivalent replacements of the technical solutions of the present application do not depart from the spirit and scope of the technical solutions of the present application, and should be encompassed within the scope of the claims of the present application.

The various embodiments described above can be combined to provide further embodiments. All of the U.S. patents, U.S. patent application publications, U.S. patent applications, foreign patents, foreign patent applications and non-patent publications referred to in this specification and/or listed in the Application Data Sheet are incorporated



herein by reference, in their entirety. Aspects of the embodiments can be modified, if necessary to employ concepts of the various patents, applications and publications to provide yet further embodiments.

These and other changes can be made to the embodiments in light of the above-detailed description. In general, in the following claims, the terms used should not be construed to limit the claims to the specific embodiments disclosed in the specification and the claims, but should be construed to include all possible embodiments along with the full scope of equivalents to which such claims are entitled. Accordingly, the claims are not limited by the disclosure.

The invention claimed is:

1. A lifting equipment, comprising:

a traction machine, a climbing member, a guide rail and a lifting vehicle, wherein the guide rail is arranged on the climbing member,

wherein the traction machine comprises:

one or more traction pulleys;

first and second fixed pulleys for changing directions of one or more traction ropes;

the one or more traction ropes driven by the one or more traction pulleys and the first and second fixed pulleys, wherein the first fixed pulley is provided with a sensor sensing member rotating with the first fixed pulley;

a traction machine sensor arranged beside the first fixed pulley, the traction machine sensor configured to detect a rotation speed of the sensor sensing member, and send the detected rotation speed data to the traction machine;

a controller in the traction machine that receives the detected rotation speed data and controls a rotation of the one or more traction pulleys according to the detected rotation speed data of the traction machine sensor,

wherein the controller and the traction machine sensor detect whether the one or more traction ropes are slipping or whether an operating speed is normal, and in response to detecting the traction machine has an abnormal operation, stop the abnormal operation of the traction machine;

wherein the guide rail is provided with a closing groove extending along a longitudinal direction of the guide rail, and an anti-falling device capable of ascending and descending along the guide rail is mounted on the lifting vehicle, the anti-falling device comprises an anti-falling main body embedded in the closing groove, the anti-falling main body is provided with first rollers in the closing groove and capable of sliding along an inner wall of the closing groove, wherein the anti-falling device further comprises a second roller arranged at an opening of the closing groove and capable of sliding along the opening,

wherein a number of the first rollers is at least two, and the first rollers are mounted on both sides of the anti-falling main body through a first roll shaft, wherein the second roller is mounted to a front surface of the anti-falling main body through a second roll shaft, and the second roll shaft is perpendicular to the first roll shaft,

wherein one side away from the closing groove of the second roller is provided with a wear plate, wherein the second roll shaft is fixed to the lifting vehicle by sequentially penetrating through the anti-falling main body, the second roller, a first positioning sleeve and the wear plate; the wear plate is mounted to the second roll shaft through the first positioning sleeve.

2. The lifting equipment of claim 1, wherein a first elastic member capable of extending and retracting along a second roll shaft direction is arranged between the second roller and the anti-falling main body.

3. The lifting equipment of claim 2, wherein the second roller is connected to an upper portion of the anti-falling main body, and a lower portion of the anti-falling main body is provided with a second positioning sleeve, the second positioning sleeve is mounted to the front surface of the anti-falling main body through a third roll shaft which is parallel to the second roll shaft, and a second elastic member capable of extending and retracting along a length direction of the third roll shaft is arranged between the second positioning sleeve and the anti-falling main body.

4. The lifting equipment of claim 1, wherein one side facing the climbing member of the guide rail is provided with friction protrusions.

5. The lifting equipment of claim 1, wherein a top portion of the guide rail is mounted with guiding pulleys for a traction rope, and a bottom portion of the guide rail is provided with a tensioning device for the traction rope.

6. The lifting equipment of claim 1, wherein the lifting vehicle is connected to the one or more traction ropes, and the climbing member is provided with a traction rope protection assembly, wherein the traction rope protection assembly comprises idler rollers and a mounting bracket for mounting the idler rollers to the climbing member, and wherein a rotation direction of the idler rollers is perpendicular to a lifting direction of the one or more traction ropes, and the idler rollers are between the climbing member and the one or more traction ropes.

7. The lifting equipment of claim 1, wherein a double-hand switch is provided on the lifting vehicle.

8. The lifting equipment of claim 1, wherein the controller of the traction machine is connected to a bus of the controller, and the bus of the controller is provided with a resistance module.

9. A lifting equipment comprising a traction machine, a climbing member, a guide rail, a lifting vehicle, and a stall braking device mounted on the lifting vehicle,

wherein the traction machine comprises:

one or more traction pulleys;

first and second fixed pulleys for changing directions of one or more traction ropes;

the one or more traction ropes driven by the one or more traction pulleys and the first and second fixed pulleys, wherein the first fixed pulley is provided with a sensor sensing member rotating with the first fixed pulley;

a traction machine sensor arranged beside the first fixed pulley, the traction machine sensor configured to detect a rotation speed of the sensor sensing member, and send the detected rotation speed data to the traction machine;

a controller in the traction machine that receives the detected rotation speed data and controls a rotation of the one or more traction pulleys according to the detected rotation speed data of the traction machine sensor,

wherein the controller and the traction machine sensor detect whether the one or more traction ropes are slipping or whether an operating speed is normal, and in response to detecting the traction machine has an abnormal operation, stop the abnormal operation of the traction machine,



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wherein the guide rail is arranged on the climbing member, the stall braking device comprises a speed-limiting assembly and a safety protection assembly, wherein the speed-limiting assembly comprises a speed measuring wheel, a centrifugal block and a braking cam, wherein the centrifugal block is fixed to the speed measuring wheel and rotates with the speed measuring wheel, and when a rotation speed of the speed measuring wheel is not less than a set speed, the centrifugal block opens and connects the braking cam so as to drive the braking cam to rotate, wherein the speed measuring wheel and the centrifugal block are fixedly mounted on a main shaft, and the speed measuring wheel drives the centrifugal block to rotate through the main shaft, wherein the braking cam is fixedly mounted on a transmission shaft, and the centrifugal block is connected to the transmission shaft through a transmission sleeve when opened.

10. The lifting equipment of claim 9, wherein the main shaft is provided with a first through hole in a radial direction, wherein after a centrifugal spring passes through the first through hole, each of two ends of the centrifugal spring is fixed with a centrifugal block respectively; lugs are formed on the main shaft, and the lug is provided with a second through hole extending axially along the main shaft, and wherein the centrifugal block is hinged to the second through hole through a pin shaft, so that the centrifugal block rotates with the second through hole as an axis and opens.

11. The lifting equipment of claim 10, wherein a first circumferential limiting member is formed on an outer surface of the centrifugal block, and a second circumferential limiting member is formed on an inner surface of the transmission sleeve, and wherein when the centrifugal block opens, the first circumferential limiting member and the second circumferential limiting member are circumferentially locked.

12. The lifting equipment of claim 11, wherein the outer surface of the centrifugal block comprises two first involute surfaces, and the first circumferential limiting member is formed between the first involute surfaces, wherein the inner surface of the transmission sleeve comprises two second involute surfaces, and the second circumferential limiting member is formed between the second involute surfaces.

13. The lifting equipment of claim 9, wherein the safety protection assembly comprises a locking block hinged on the lifting vehicle, wherein when the lifting vehicle operates normally, the locking block compresses a spring, and wherein when the lifting vehicle stalls, the spring ejects the locking block so that the locking block is embedded in a locking hole of the guide rail.

14. The lifting equipment of claim 9, wherein the controller of the traction machine is connected to a bus of the controller, and the bus of the controller is provided with a resistance module.

15. A lifting equipment, comprising: a traction machine, a climbing member, a guide rail a lifting vehicle, and wherein the guide rail is arranged on the climbing member, wherein the traction machine comprises:

- one or more traction pulleys;
- first and second fixed pulleys for changing directions of one or more traction ropes;
- the one or more traction ropes driven by the one or more traction pulleys and the first and second fixed

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pulleys, wherein the first fixed pulley is provided with a sensor sensing member rotating with the first fixed pulley;

a traction machine sensor arranged beside the first fixed pulley, the traction machine sensor configured to detect a rotation speed of the sensor sensing member, and send the detected rotation speed data to the traction machine;

a controller in the traction machine that receives the detected rotation speed data and controls a rotation of the one or more traction pulleys according to the detected rotation speed data of the traction machine sensor,

wherein the controller and the traction machine sensor detect whether the one or more traction ropes are slipping or whether an operating speed is normal, and in response to detecting the traction machine has an abnormal operation, stop the abnormal operation of the traction machine;

wherein the guide rail is provided with a closing groove extending along a longitudinal direction of the guide rail, and an anti-falling device capable of ascending and descending along the guide rail is mounted on the lifting vehicle, the anti-falling device comprises an anti-falling main body embedded in the closing groove, the anti-falling main body is provided with first rollers in the closing groove and capable of sliding along an inner wall of the closing groove, wherein the anti-falling device further comprises a second roller arranged at an opening of the closing groove and capable of sliding along the opening,

wherein triggering blocks are arranged on the climbing member or the guide rail corresponding to places where space changes, and wherein when the lifting vehicle runs to the triggering block, the triggering block sends current position information to the controller of the traction machine, and the controller controls an operating speed of the lifting vehicle according to the position information.

16. The lifting equipment of claim 15, wherein the controller of the traction machine is connected to a bus of the controller, and the bus of the controller is provided with a resistance module.

17. The lifting equipment of claim 15, wherein one side facing the climbing member of the guide rail is provided with friction protrusions.

18. The lifting equipment of claim 15, wherein a top portion of the guide rail is mounted with guiding pulleys for a traction rope, and a bottom portion of the guide rail is provided with a tensioning device for the traction rope.

19. The lifting equipment of claim 15, wherein the lifting vehicle is connected to the one or more traction ropes, and the climbing member is provided with a traction rope protection assembly, wherein the traction rope protection assembly comprises idler rollers and a mounting bracket for mounting the idler rollers to the climbing member, and wherein a rotation direction of the idler rollers is perpendicular to a lifting direction of the one or more traction ropes, and the idler rollers are between the climbing member and the one or more traction ropes.

20. The lifting equipment of claim 15, wherein a double-hand switch is provided on the lifting vehicle.



UNITED STATES PATENT AND TRADEMARK OFFICE  
**CERTIFICATE OF CORRECTION**

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DATED : August 23, 2022  
INVENTOR(S) : Zizhao Liu et al.

Page 1 of 1

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the Claims

Column 19, Claim 15, Line 56:

“A lifting equipment, comprising:” should read: --A lifting equipment comprising:--

Signed and Sealed this  
Twenty-fifth Day of June, 2024  
*Katherine Kelly Vidal*

Katherine Kelly Vidal  
*Director of the United States Patent and Trademark Office*